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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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Thoughts After Yeoman

A FIGHTER COMMAND C-in-C who starts a practice alert at 5.27 on a Saturday afternoon, the comfortable nub of an Englishman's weekend, is not a man to be taken lightly. Nor was Air Marshal Sir Hector McGregor otherwise unexacting in his demands for Exercise Yeoman, talking as he did of "straining the machine to the maximum . . . to see how it works." Part of this strain was artificial, through intense electronic jamming; part natural, for weather conditions (as depicted in some of Gordon Horner's drawings on pages 754-755) were marginal. But however successful the exercise its manned-bomber context demands particular deliberation. This threat still exists. It provides a ready-made argument for the retention of Fighter Command in its present form, and exercises on this assumption rightly set up targets within the Command's killing capability. But how much longer will this continue to be realistic? Are we, perhaps, deluding ourselves by sentimental regard for manned fighters? Two Lightnings participated in Yeoman, as part of their indoctrination, and no doubt Lightning squadrons will participate in subsequent years, for in Sir Hector's words, "even when the missile becomes the preponderant threat the manned aircraft will . . . be there as a counterpart for many years." But how much longer will he need to bother with the latter? How many years does "many" imply? "A few" might have been more apt—prefaced by "possibly."

Twenty-one this Year

THERE is one chap who has not missed an SBAC Display since the pre-war years. He is the chap who edges alongside just as one is enjoying Treble One or a Triple X in order to advise one to make the most of it, because—take it from him—if these Farnborough displays are going to be held at all in future (and even that is *very* doubtful, what with missiles taking over, and the impossibility of showing the real qualities of transport aircraft, and the tightening up of money, and the lack of anything new, anyway)—if, as he says, it is to go on at all, then it will be held only every *other* year—and on a minor scale at that.

This chap—and he is known to us all—will, in this year of the 21st SBAC Display, have a fine fresh crop of calamities to confide, what with reduced budgets, fewer orders and only two companies remaining in the industry. Unhappily for him, his hosts the SBAC remain as reluctant as ever to entertain his views. They have just had the temerity to announce, for instance, that the total floor area occupied by Ordinary Members' stands (that is, the makers of aircraft, engines and missiles) will be increased this year by 8,000 sq ft; that the number of Associate Members' stands (equipment and material manufacturers) will remain at about last year's level; and that there will be an increase of 20 per cent in the number of covered units in the outside equipment display. The guided-weapons park will be increased in area, in anticipation of presenting a larger and more varied selection of missiles. "In fact," the Society reports, "it looks as if the exhibition building, equipment display and the area allotted to exhibitors' enclosures will have to be enlarged for future Displays since, this year, there is a waiting list for all three." They go on to report an extensive reconstruction scheme, improved parking facilities, and the laying down of a new motor road to the exhibition building.

It would appear from all this that the Society's members really expect to go on building aeroplanes, showing them at Farnborough and selling them. Our friend had better take them aside for a quiet word. They don't seem to realize just how bad things are.

FROM ALL QUARTERS

Air Aid in Chile

A LARGE-SCALE rescue and relief operation was mounted by the USAF as soon as the disastrous scale of last week's earthquakes in Southern Chile became apparent. MATS, using 65 transport aircraft, mainly C-124s, flew-in doctors, nurses and field hospital equipment, and were planning to evacuate thousands of homeless children. Helicopters provided links with the more isolated communities.

The Britannia of No 99 Squadron, RAF, which was taking part in the goodwill visit of the Air Minister, George Ward, to five South American countries, was diverted from Buenos Aires to Chile to take part in the work. On board were medical supplies, food and clothing given by the British Hospital and by British and Argentine firms in Buenos Aires.

Earlier in the week, the visiting RAF force had created immense interest in the capital, two Vulcans of No 101 Sqn and a Comet of No 216 Sqn staging a fly-past in vic formation, with the Comet leading.

Rolls-Royce and Income Tax

MANY other firms may be affected advantageously by the ruling of Mr Justice Pennycuick in the Chancery Division on May 27 that Rolls-Royce Ltd should not be assessed for taxation purposes on remuneration made to them in return for what might generally be termed "technical know-how." The company had concluded aircraft gas-turbine licensing agreements with Argentina, Australia, Belgium, China, France, Sweden and the USA, between the years 1948 and 1955. Over this period their income from these licence fees amounted to some £1.2m.

Rolls-Royce had been assessed on this for income tax, profits tax, excess-profits tax and excess-profits levy. They had appealed, and the Special Commissioners had allowed the appeal. The recent action was brought by the Crown against the Commissioners' decision. His Lordship found that, contrary to the Crown's contention that technical knowledge was "sold" just as a turbojet might be sold, parting with secret knowledge laboriously acquired over the years was actually a disposition of part of the company's capital assets, not to be brought into account when computing revenue profits from ordinary trading.

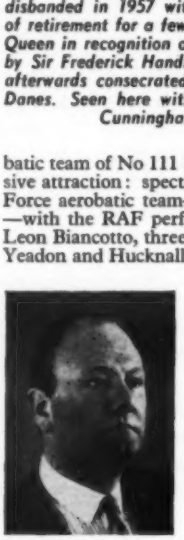
Tyne Investigation

ON May 27 Rolls-Royce Ltd announced that the Tyne turboprop (described in *Flight* for April 22) has suffered mechanical failure of a nature which may not be immediately rectifiable. The trouble arose during bench testing of a Tyne at Derby and at one point during the run a compressor disc failed. Although an isolated occurrence, the company found "confirmatory evidence" on another engine. A full technical investigation is in hand, which naturally extends to the many engines already delivered, and Rolls-Royce have recommended that flying of Vanguards and CL-44s be suspended until the fault can be rectified. A note on the effect which this has had on BEA is given in our Air Commerce section.

Whit-Monday Displays

THREE big air displays are being held next Monday (Whit-Monday, June 6): at North Weald, Essex; Hucknall, Notts; and Yeadon, Yorks. The first two are organized by the RAFA and the Yeadon pageant by SSAFA. Reference to the Hucknall display is made on page 778, and both Yeadon and North Weald will share with it a performance by the Hunter formation aerobatic team of No 111 Sqn. At Yeadon, however, there is an exclusive attraction: spectators will be able to compare the Italian Air Force aerobatic team—the "Getti Tonanti," mounted on F-84Fs—with the RAF performers. The famous French aerobatic pilot Leon Biancotto, three times world champion, is appearing at both Yeadon and Hucknall in a Nord 3202.

NOSTALGIC OCCASION: In London on Saturday a famous Auxiliary night-fighter squadron, No 604 (County of Middlesex), which was disbanded in 1957 with the 19 other RAuxAF squadrons, came out of retirement for a few hours to receive its standard. Awarded by the Queen in recognition of 25 years' service, the standard was presented by Sir Frederick Handley Page as Lord Lieutenant of Middlesex and afterwards consecrated and laid up in the RAF church, St Clement Danes. Seen here with Sir Frederick at the parade are G/C John Cunningham (centre) and S/L K. Courtnage



RETIREMENT of Richard Fairey from the vice-chairmanship and board of the Fairey Co Ltd, on medical advice, was announced last Monday. During the war he served in the ATA and while on his way to America by sea was torpedoed and spent five days in an open boat, as a result of which he lost both legs through frostbite. Within eight months he was flying again, and has regularly flown fixed-wing aircraft and helicopters ever since. Elder son of the late Sir Richard Fairey, he joined his father's firm in 1936

BAC Posts

IN addition to the British Aircraft Corporation directorships, details of which are given on page 752, three appointments in the corporation have been announced. Geoffrey E. Knight becomes commercial manager; Eric L. Beverley sales manager (guided weapons); and Reginald H. Sawyer chief accountant. Mr Knight has been commercial director of Bristol Aircraft Ltd since August 1956; Mr Beverley has been commercial manager of the guided weapons division of English Electric for the past eight years; and Mr Sawyer joined Vickers Ltd in 1955 and in the following year was made assistant chief accountant of Vickers-Armstrongs (Aircraft) Ltd.

Open Day at Wethersfield

SMARTLY at 2 p.m. last Saturday the report of an F-100 afterburner announced the opening of the display at Wethersfield, Essex, where the 20th Tactical Fighter Wing of the USAF was "at home" on the final week-end of the series of Armed Forces Day events. A high-speed pass had begun the Skyblazers' pro-

GREBE TO JAVELIN: Now equipped with Gloster Javelin FAW.8 all-weather fighters (two Bristol Siddeley Sapphire with limited reheat), No 25 Squadron was one of the first in the Service to be equipped with fighters of Gloster manufacture (Grebes, in 1925). This lively impression of four of the Squadron's Javelins was recently secured by Gloster photographer Russell Adams

NEW TAIL on the Westland (Bristol) Belvedere (two Napier Gazelle) has, as shown, the two vertical outboard fins fixed below, and at an anhedral angle to, the extremities

gramme of precision manœuvres, which suffered a little from an excess of altitude. Their colourful livery is enhanced, on landing, by tricolour brake 'chutes; but it was noted that the tail fin of Capt Kramer's mount has become steadily blacker from its long and close proximity to the leader's afterburner.

With the ensuing take-off of a resident squadron of F-100s the cumulus-studded sky held a surfeit of this type of aircraft, but variety was soon available in the shape of three generations of RAF fighters—the Bristol Fighter, Hurricane and Hunter 6. All three were displayed individually in a manner becoming their years.

Whereas last year's display included only the F-100 and F-101 in the "century series," this year there were examples of the F-102A and F-104C, although both made all-too-brief appearances in the flying. More generous, however, were individual RAF demonstrations by a Provost, two Chipmunks, and a Vampire Trainer, but all were a joy to watch, with their arresting fluorescent orange trim.

In the bomber category, the only American type present was the B-66. The RAF contribution in this field, a Valiant, gave an impressive show of speed-range after executing a circuit and slow pass before undercarriage retraction.

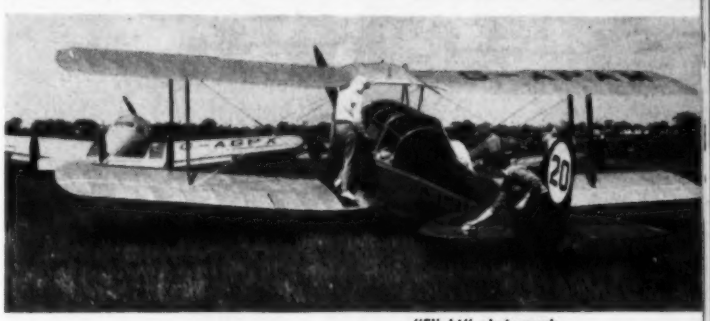
Transports were represented in the air by an RAF Britannia, barely glimpsed in passing, and, more informatively, by a C-130, which gained height at a phenomenal rate after appearing to use little more than a quarter of the runway. Four colourful Turbulents from the Tiger Club concluded their frolics by engaging in competitive tape-cutting.

Remaining events in the two-and-a-half-hour programme were a T-33 Jato take-off, an air-refuelling KB-50 (B-66, F-100, and F-101 in attendance) and a LABS bombing simulation by an F-100.

NATO countries were well represented in the static park, with F-84Fs of the Dutch and Belgian Air Forces, an RF-84F of the West German Air Force, Super Mystère and Vautour IIN from France, and—seen for the first time—F-100Fs in the unaccustomed markings of the Turkish and Danish air forces. Also displayed were a CF-100-4, F-86D Sabre, Noratlas, C-119G, Beverley, Shackleton 3, Javelin, Varsity, and Meteor 7s.

Skegness Weekend

THERE are more ways than one of getting to a rally. In her Turbulent, Janet Ferguson, a member of the British Woman Pilots' Association, encountered a bus on her way up to the start last Friday of the Skegness International Air Rally. But then she had a more exciting trip than most other entrants; a faltering engine over the Wash precipitated a descent into a barley field. The following day a working party manhandled the aircraft along a narrow lane (telegraph posts and the local bus presented some difficulties *en route*) and into a field of young sugar beet. After a couple of dummy runs, she made a successful take-off and, grinning broadly, was accompanied by *Flight's* Gemini back to the Skegness Airfield at Ingoldmells.



"Flight" photograph

CHANGE FROM HOUSEWORK for Sheila Scott and her team, who won a "beauty prize" at Skegness with her Jackaroo (report, Col 1)

Miss Ferguson was one of a dozen or so members of the BWPA who had chosen the rally at Skegness for their spring flying weekend. Although the event again lacked international flavour it was good fun, and there were three competitions in which pilots could participate. The first—one of pure chance—was the "sealed time of arrival" game on Friday afternoon. The second, and the hallmark of this rally, was a navigation competition and the third was a *concours d'élégance* on Sunday morning.

An Auster J1 flown by J. W. Steel arrived very nearly at the right time and the navigation competition was won by P. J. Butterfield from Stapleford Tawney in Messenger G-AGPX. He was the only competitor to locate and identify five landmarks from 1,500ft or more, the location of which was given by map references. Three other teams got four out of the five objects on the ground and the only ladies' team to enter equalled that score. Comfortably the winner of the *concours d'élégance* was the attractive metalescent blue Jackaroo G-APAM, owned and flown by Miss Sheila Scott. She and her team went to a great deal of trouble to polish it properly before the judging.

In spite of this rally being widely advertised, only nine crews took part. Although of modest scope it deserves better success than that.

IN BRIEF

Indian Defence Ministry officials are visiting the USA, where it is understood they will negotiate to buy Sikorsky S-62s.

A new British out-and-return glider distance record was set up by A. J. Stone on May 29 in a Slingsby Skylark 3B. The flight was from Lasham to Bridgnorth, Shropshire, and back, a total distance of 220 miles, and the time taken was 6hr 50min. On the following day Mr Stone repeated this flight, taking 7hr 35min.

AVM Sir Laurence Sinclair, GM, has been appointed controller of ground services at the MoA in succession to E. A. Armstrong, who is retiring from the public service. Sir Laurence, who will be retiring from the RAF, is at present Commandant of the Joint Services Staff College and will take up his new post on July 1.

Max Conrad's 6,966.75-mile Morocco - Texas flight in a Piper Comanche on November 26, 1959, has been confirmed by the FAI as a straight-line-distance record for light aircraft of 1,000-1,750kg (2,204-3,858lb) gross weight. It exceeds by some 2,000 miles William P. Odom's Beech Bonanza record which has stood since 1949.

Parachutists wishing to be considered for selection for the British team for the 1960 World Parachuting Championships (August 7-17 at Moustachavo, Bulgaria) are invited to an eliminating trial at Thruxton Aerodrome on June 11-12. Minimum qualification needed is an international C licence.

According to reports last Monday, a fleet of Russian "trawlers," said to be fitted with comprehensive electronic systems, is at present stationed in the general area of the South Uist rocket range in the Outer Hebrides. During the first Corporal launching by 27 GW Regiment, Royal Artillery, which took place on May 24, tracking teams in various parts of the range—especially at St Kilda, some 60 miles West of the range-head—are said to have found their equipment jammed. It is difficult to determine what useful purpose the ships could have in this area; it is, however, gratifying to note that the range is at last operational.

Aircraft from the Shuttleworth Collection, including the Blériot Monoplane and a Spitfire, are being displayed at the Croydon Millenary exhibition and fair being held at Croydon Airport from June 14 to 25.

It was announced officially in Brussels on May 27 that the Belgian Government will purchase an initial batch of 50 Lockheed F-104Gs for the Belgian Air Force. A further 50 would be ordered "after 1962." All will be manufactured in Europe.

A new world gliding record for goal and long-distance flights has been claimed for V. Zejda of Czechoslovakia. The sailplane was an L-21 Spartak and the distance approximately 560 miles, from Zamberk Airfield, in Czechoslovakia, to Sighisoara, Rumania.

Rescues by Link Luckett in a Hiller 12E helicopter last month at 18,000ft on Mt McKinley, in Alaska, were claimed to be the highest aircraft landings and take-offs ever made. Luckett made six landings and take-offs in rescuing two climbers, bringing supplies and testing take-off load conditions.

An Open Day for invited guests is being held at the College of Aeronautics, Cranfield, on June 10, followed on the next day, Saturday (10 a.m. to 6 p.m.) by a public Open Day. Also scheduled for June 11 at Cranfield is the annual general meeting and dinner of the Cranfield Society, the association of former students of the college.

Described as "the first aircraft manufacturing venture in South America to be established by US industry," a new enterprise named Aviones Lockheed-Kaiser Argentina has been set up by Lockheed Aircraft International, a subsidiary of the Lockheed Corporation, and Industries Kaiser, the largest manufacturing company in Argentina.

Late last month, from Cape Canaveral, Convair's great ICBM flew two missions of singular consequence. At far left is the departure of Atlas 56D on its 9,040-mile flight on May 20; the other vehicle is Midas (see below), boosted by Atlas 45D and Agena on May 24

Missiles and Spaceflight

MIDAS IN ORBIT

The first spacecraft openly intended to fulfil a military function is now in orbit round the Earth. Launched by the US Air Force on May 24 it is the first of a number of satellites intended to detect enemy missile launchings under the name Midas (Missile Defence Alarm System). When fully operational such a system could theoretically give the United States between 20 and 37min warning of attack, more than double the best available from the BMEWS network.

It was 25 months ago that the Department of Defense became convinced that a satellite at a height of some 300 miles could carry equipment capable of detecting the infra-red radiation emitted by the propulsion of a large ballistic missile. It might be thought that even an advanced cryogenic IR sensing system might have difficulty in distinguishing between a missile launch and—for example—a large building on fire. So obvious a shortcoming could be counteracted by making the sensitive cell respond only to a very narrow band of wavelengths. The flame from a large rocket engine is at a significantly higher temperature than any other terrestrial heat source of comparable magnitude, and accordingly the satellite equipment could be made insensitive to all wavelengths greater than those appropriate to temperatures of the order of, say, 3,500°K.

Nevertheless, when this discriminatory problem had been solved there remained many others of a fundamental nature. Even during a full-range ICBM launch the engines burn for less than 5min, and the flame must be spotted before burnout or cutoff. The launching site of a potential enemy could be virtually anywhere in his territory, so that millions of square miles must be examined in minute detail, with no single square mile being left unattended for more than 5min at the most. The satellite must be highly stable, and capable of orienting its sensitive receiver system with great accuracy; and it may be that this must be done not only towards the Earth's surface, but also on vehicles which may already have reached an altitude of the same order as that of the satellite itself.

In the event the USAF considered that 12 to 15 Midas satellites could provide complete coverage of the suggested probable aggressor. A major economic unknown is how altitude and satellite lifetime can be optimized; if each satellite had to be replaced every six months such a system would be a severe strain on any nation's economy. In scale and complexity the Midas vehicle represents a major advance over anything previously placed in orbit by the United States. The vehicles employed are Atlas coupled with an Agena B second stage (*Flight*, May 13, pages 650-1).

The first Midas was launched from Complex 14 at Cape Canaveral on February 25, but was rendered abortive by faulty stage-separation. Midas 2 left the pad at 6.37 p.m. on May 24. Gross weight in orbit is approximately 5,000lb and instrumentation payload some 3,600lb. The USAF computing centre at Sunnyvale, Cal, failed to monitor early orbits, and at the time of going to Press the only orbital data have been determined by manual calculations: period 94.34min; apogee, 316 miles, perigee, 300 miles. The orbit is essentially equatorial and will not pass over the Soviet Union. The USAF stated the day after the launching that the airborne equipment appeared to be working perfectly, and that it would be tested by checking its response against large flares to be lit at Edwards and Vandenberg and possibly against carefully timed missile launchings. The next day, however, Midas 2 developed a transmitter fault, which appears to have silenced it entirely.

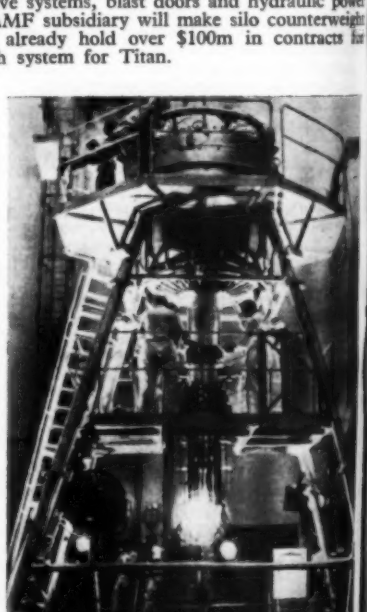
BLACK KNIGHT No 6

The British Commonwealth programme into the problems of hypersonic re-entry appears to have taken a significant step forward with the launch of a two-stage Black Knight at Woomera late on May 24. Like the previous five Black Knight firings it was a fully successful shot—in fact, results were officially described as "exceeding expectations."

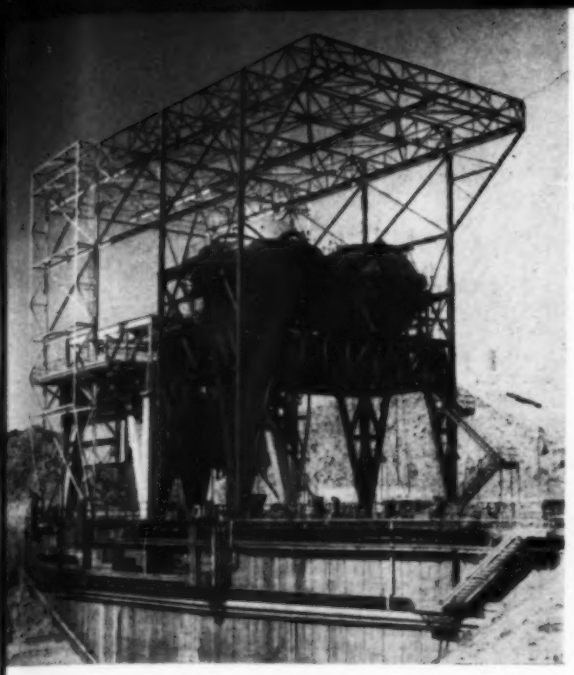
Earlier Black Knight vehicles have all had a single stage, the total impulse to the payload being provided by a rear propulsion bay containing a Bristol Siddeley Gamma 201 engine. In the sixth Black Knight a separable second-stage was added, with its own solid-propellant motor. As in earlier firings the re-entry vehicle appears to have been designed to simulate (either on full or a reduced scale) that of a military ballistic missile. Single-stage Black Knights have reached a height of 500 miles. Shot No 6 could have exceeded 1,000 miles, but the second stage was programmed to reach apogee and then fire after the start of the downwards trajectory. Thus the most severe re-entry conditions were achieved, a speed greater than 10,000 m.p.h. being reached at relatively high atmospheric density. The nosecone was fully instrumented, and after its recovery from the impact area the instruments were sent for examination to the RAE.

ATLAS GOES UNDERGROUND

Carter L. Burgess, president of American Machine & Foundry (and former president of TWA), announced last month that AMF have received a $3.8m contract from Convair Astronautics for the design and development of a launch system for fully hardened underground Atlas emplacements. AMF also received letter authorization for approximately $6.5m for construction, and the total production contract is expected to exceed $25m. The work will involve the design and fabrication of crib suspension and launch-platform drive systems, blast doors and hydraulic power packages; and an AMF subsidiary will make silo counterweight guide rails. AMF already hold over $100m in contracts for underground launch system for Titan.



Under Project Rover the US Atomic Energy Commission is developing a nuclear rocket engine for outer space. The second prototype engine (right) designated Kiwi-A Prime, was recently shown to the Press at the AEC Nevada test site and is expected to be ready for firing in July



This test stand (left) nearing completion at Edwards AFB is designed for static testing of the Rocketdyne F-1, most powerful engine in the world. Below are some of the nitrogen purging bottles

TESTING 1,500,000lb THRUST

Although it is not yet matched with any clearly conceived vehicle the F-1 engine, currently under development by the Rocketdyne Division of NAA for NASA, is fast approaching the stage where the complete powerplant will be subjected to hot firings. The first stand, for a single F-1, is nearing completion at Edwards AFB (see illustrations). The spheres above the engine hold liquid oxygen and RP-1 fuel, the latter being fed from a storage tank just visible on the hill in the background. The blockhouse for the control of this stand and of others in the vicinity is under another hill nearby. The smaller of the two photographs shows the battery of nitrogen tanks with which the complete powerplant is purged before each firing.

As we have already described (*Flight*, February 12 and 26), the F-1 is a single-chamber engine with a sea-level rating of 1,500,000lb. One such chamber could drive the first stage of Saturn, but the main application envisaged is for a quartet of F-1s in an entirely new NASA vehicle named Nova. One F-1 will stand approximately 25ft high and weigh 15,000lb. For over a year runs at greater than 1,000,000lb thrust have been made with an uncooled chamber using an F-1 injector. A complete powerplant may be in the Edwards stand this month and neighbouring stands will accommodate clusters of two and four engines for future development.

LONG TOM AND AEOLUS

Details of the two Australian sounding rockets Long Tom and Aeolus have been given by D. A. H. Bird of the Flight Projects Group, Weapons Research Establishment, in a paper in the May issue of the *Royal Aeronautical Society Journal*. These rockets, he said, represented the first to be designed and built at WRE which could be classed as high-altitude rockets; also, they had made possible the provision of relatively cheap and readily available vehicles for upper-atmosphere research. The need for "sighter" rockets and instrumentation test vehicles capable of reaching 200,000-500,000ft followed the development of ground and airborne instrumentation at Woomera to cope with Skylark and Black Knight firings.

The only "bought out" items used in the two rockets are the solid fuel Mayfly motors designed and developed by the Rocket Propulsion Establishment, Westcott. The Long Tom is a two-stage vehicle using three Mayflies mounted in parallel as the first stage and a single Mayfly as second stage. Aeolus is essentially a Long Tom second stage boosted by seven 5in light alloy plastic star motors in the first stage.

Long Tom carries its instrumentation in a 9.2in diameter, 35in long compartment forward of the second-stage motor. Space for instrumentation is also available in the nosecone of the rocket. The cylindrical section can be subdivided by pressure-type bulkheads to provide a forward compartment sealed at ground-level pressure and a rear one vented to atmosphere. The gross weight of the first stage is 1,400lb, the second-stage weight varying between 520 and 700lb, depending on the instrumentation carried. The weight of the Aeolus first stage is 600lb and its second stage varies between 520 and 650lb.

Comparing Long Tom with the Skylark rocket, Mr Bird said: "The useful payload is of the same order—150lb for Skylark, 130lb for Long Tom. Skylark is fired from a launcher some 100ft in length; Long Tom employs a 10ft launcher, yet the wind dispersion problem with Long Tom is slightly less severe than with Skylark. The Skylark total impulse is roughly twice that of Long Tom and yet the peak altitudes achieved are comparable, about 500,000ft for Skylark, 400,000ft for Long Tom. Although the useful payloads are of the same order, Skylark actually lifts a total dead weight of 800lb to 500,000ft, while Long Tom lifts only 400lb to 400,000ft.

"The significant factor is that Skylark was designed to lift its payload, which consists of a wide variety of research apparatus, into the upper atmosphere without subjecting it to very high acceleration. Skylark does not exceed an acceleration of 9g at any stage of its ascent, whereas with Aeolus and Long Tom the type of apparatus carried as payload must be able to withstand accelerations as high as 50g."

ANGLO-CANADIAN-US RESEARCH

The Radio Research Station at Ditton Park, near Slough, plans to co-operate in the joint Canadian-American satellite project for sounding the ionosphere from above. This work will include two-way sounding and transmission between the station's ionospheric observatories at Slough and Singapore, and possibly later at Ibadan and Port Stanley. The use of an antarctic observatory on the Falkland Islands is also under consideration. This information was contained in the 1959 Report of the Research Council of the Department of Scientific and Industrial Research, published on May 26.

The report also confirmed the news given last December, and reported in *Flight* of December 11, that the whole subject of satellites and other space research would occupy about half the total staff effort of the station, i.e. some 80 scientists and assistants. A mock-up of the Canadian-US satellite (described in *Flight* of March 4 last) is illustrated in the photograph below.

The organizations sponsoring the satellite project are NASA and the Defence Research Telecommunications Establishment (a unit of the Canadian Defence Research Board) in Ottawa. The experiment has two main objectives: (1) to examine and record fundamental scientific information about the structure of upper levels of the ionosphere by using a radio sounder above the ionized

Mock-up of the joint Canadian-US sweep - frequency topside sounder satellite, to be launched by Thor-Delta from Vandenberg late next year. Radio Research Station interest in this project is reported on this page

Missiles and Spaceflight . . .

layers; (2) to provide information about galactic noise or the radio signals which emanate from outer space. This information is needed both by Canada and the United States as a phase of their research programmes aimed at improving long-distance telecommunications.

The DRB satellite, which will be launched in a near-polar orbit, will be constructed of aluminium and glass-fibre, nearly round in shape and girdled by banks of solar cells. The diameter of the girdle will be about 42in and the weight of the complete satellite will be of the order of 200lb.

The experiment will require the construction of four satellites by the Ottawa establishment. One will be for environmental tests on the ground, another to be tested as the prototype and two at the launching site to provide a reasonable assurance of a successful experiment.

The long wavelengths used for sounding the ionosphere require long satellite antennas. The two 20ft antennas projecting from the sides of the vehicle will be the longest used in satellites to date.

DRTE will operate four receiving stations in Canada, and NASA will provide sounding rockets to test the prototype payload.

THE US NAVY'S TRANSIT

The United States Navy revealed recently details of its Transit project for putting navigation satellites into orbit. According to the Navy, the Transit vehicle can be put into an orbit that will last 16 months and the radio transmitter aboard the vehicle will be able to operate from battery power for a year.

Transit would be especially helpful to ships in the North Atlantic during the winter, it is claimed, because that area frequently is clouded over for months at a time when it is not possible for ships to get visual sightings of the Sun or stars. As a result, they must use radio and other means which are particularly hazardous in wartime.

If two Transit satellites were in known orbits at or near 67½ and 22½°, however, they would provide suitable coverage of the world so that ships at sea could locate themselves with half-mile accuracy. It would not be necessary to "talk" to the satellites, but merely to listen—thus radio silence could be maintained at all times.

To work out positions from Transit data, the Navy would install computers costing about $75,000 aboard its ships. Commercial shipping could get a satisfactory receiver and computer so as to make use of Transit data for about $25,000, according to Navy estimates.

Martin issued this photograph of the launching of a US Air Force Trainer Bullpup last week. Designated TGAM-83, it is much cheaper than the operational missile; most will be used by F-100 pilots but this example is leaving a ground launcher at NATC, Patuxent River

NASA BUDGET INCREASED

Spokesmen of the US National Aeronautics and Space Administration appeared before a subcommittee of the Senate Committee on Appropriations on May 19 in Washington to request a complete restoration of the $38,985,000 cut from the $915,000,000 NASA budget for fiscal year 1961. Dr T. Keith Glennan, NASA Administrator, said, "The cut made by the House is in no way compatible with NASA's responsibilities for the initiation of long lead time projects or the acceleration of national priority programmes such as manned spaceflight and the Saturn programme. . . ." Concerning specific costs, Dr Glennan stated, "The launched cost of the first production Scouts was estimated at $700,000 and now is $915,000; the Thor-Agena cost has increased by $800,000 and the Atlas-Agena by $1,500,000. . . ."

Later, the House of Representatives and the Senate approved a joint committee report which increased the NASA budget authorization to $970m.

LOWER POWER FOR PIONEER 5

The high-power (150W) transmitter in the NASA Pioneer 5 probe is no longer being used, following an excessive power drain and an apparent deterioration in the chemical batteries carried. Communication with the probe is continuing by means of the five-watt transmitter, signals from which are being received by the large steerable radio telescope at Jodrell Bank. The probe was 13 million miles from Earth on Tuesday last, May 31.

A full-range flight of a Polaris was made from USS *Observation Island* from Cape Canaveral on May 23.

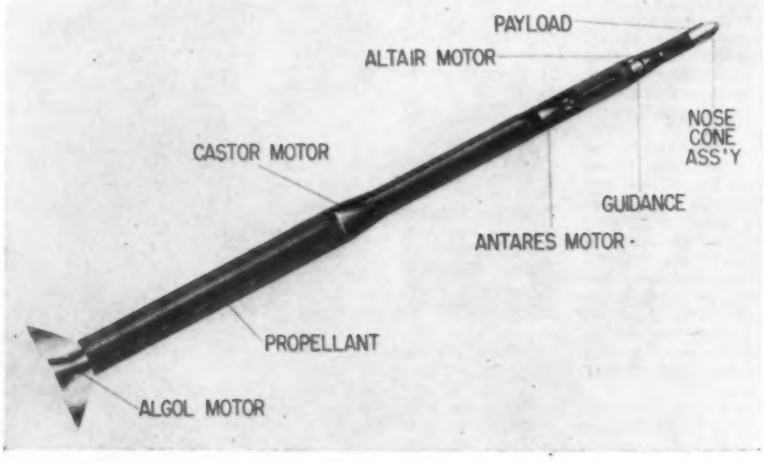
The Civil Lord of the Admiralty, Charles Ian Orr-Ewing, said in Malta last week that storage facilities for Seacat and Seaslug were to be provided in the island.

It was disclosed last week that one of NASA's X-15 aircraft reached M3.2 on May 12, in the hands of Joe Walker.

Gifts of £25,000 from Viscount Nuffield, and £25,000 from the Nuffield Foundation, have cleared the debt which was previously outstanding on the 250ft steerable radio telescope at Jodrell Bank experimental station. Total cost of the telescope was approximately £700,000.

The timing mechanism which controls remote operation of the narrow-angle camera on the NASA Tiros 1 satellite resumed operation on May 10 after having failed to respond to commands since April 2. A possible explanation is that temperature extremes may have opened and subsequently closed, a wiring contact in the timing mechanism.

As a photograph on page 746 indicates, the Atlas which flew 9,000 miles on May 20 carried a GE Mk 3 ablative nosecone and re-entry vehicle. Speed at re-entry was of the order of 17,000 m.p.h. The impact was monitored by aircraft of the USAF—a KC-135 with special long-range communications equipment and two C-54s—operating from the Union of South Africa. Target was 38°S, 38°E and flight time 52min 30sec.



This diagram of the Scout solid-propellant launching vehicle was included in a paper on the NASA space programme delivered by Dr Homer E. Newell on May 24 at the International Symposium on Rockets and Astronautics in Tokyo

Passing through London after attending the CENTO Council Meeting in Teheran, Gen Thomas D. White, USAF Chief of Staff, said that Sky Bolt can be in RAF service soon after its first delivery to SAC: "I would say 1964 for both the USAF and the RAF." He expressed great satisfaction with its development, and claimed that an airborne alert was not necessary: "There is nothing to prevent aircraft from taking off in from three to four minutes if ready crews are on hand."

The National Aeronautics and Space Administration recently awarded contracts for the development of a special camera and a radioactivity measuring device able to transmit pictures and data back from the Moon after landing there in about two years from now. Later on NASA may send an unmanned mobile instrument station to the Moon.

drag at high speed and to give improved stability. Other refinements include geared aileron tabs and a larger cockpit canopy.

The most interesting aircraft in the open class will almost certainly be the Phönix, in which Ernst-Günter Haase is defending the world-champion title which he won two years ago at Leszno in the HKS-3. The new Phönix will incorporate a tee-tail and other modifications, and it is one of the few really new types to be seen at the championships. Another high-performance newcomer is the Polish Zefir, to be flown by Makula and Popiel, which was expected to appear at Leszno in 1958 but which was not ready in time on that occasion. Other open-class entrants include six Skylark 3s, the familiar all-metal Yugoslav Meteors and an improved version of the Bréguet 901.

Although this is the second occasion in which the standard class has formed a part of the world championships, it is the first in which a large number of aircraft have been specifically designed for it. Many of the standard-class entries two years ago, inevitably, were modified versions of existing designs. For many competitors the organizing country supplies sailplanes on loan for the contest, and Germany's contribution in the standard class this year is the Ka 6, the Rudolf Kaiser design which in 1958 gained the OSTIV

PROSPECTS FOR BUTZWEILER

Sixty-seven Sailplanes Entered for the World Gliding Championships

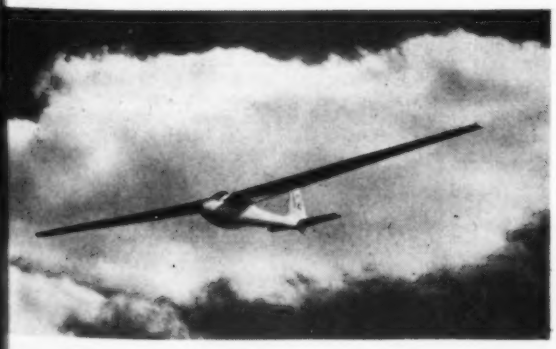
Above, open class pilots Nicholas Goodhart (in cockpit) and Anthony Deane-Drummond, seen with team captain Ann Welch at Lasham recently. Right, the third British pilot, Anthony Goodhart, favours this distinctive headgear

THE largest international gliding contest ever held opens tomorrow, June 4, at Butzweiler Airfield (previously known to the RAF as Butzerweilerhof), near Cologne. The entry list for this year's World Championships shows above all that the idea of a standard class—for "sensible" gliders as opposed to elaborate and expensive ultra-high-performance sailplanes—has indeed caught on. Of the 67 aircraft which have been entered by 27 countries, no fewer than 40 belong to the standard category.

Inspection of the entry list, which is printed on page 751, shows that 18 countries are flying sailplanes in both classes, one in the open class only and eight in the standard class only. According to the rules, there will be two World Gliding Champions, one in each class. Open and standard categories are to be marked independently, and the champion in each will be the pilot accumulating the highest marks.

Captained once again by Mrs Ann Welch, the British team will comprise Cdr Nicholas Goodhart, RN (Elliotts Olympia 419), with crew-members J. B. Jefferson and Frank Irving; Col Anthony Deane-Drummond (Slingsby Skylark 3F), with Mrs Deane-Drummond and John Archer; and Cdr Anthony Goodhart, RN (Slingsby Skylark 2B), with George Burton and Toby Harrison. The team is completed by three base-crew specialists: John Williamson (radio), C. E. Wallington (meteorologist) and Andy Gough (maintenance). Although not entered by the British team, the new Elliotts 15-metre sailplane was originally to have been flown in the championships by Tor Johannessen of Norway. Unfortunately, a ground accident to this aircraft last month at Thruxton—a Tiger Moth taxied into it—made necessary its replacement by another Newbury product, the Olympia 401.

The new Skylark 3F is an improved version of the 3B, with a revised tailplane and special tailplane setting designed to reduce



Above, Elliotts Olympia 419 (N. Goodhart); right, Slingsby Skylark 3B, an improved version of which (designated the 3F) is to be flown in the contest by Deane-Drummond

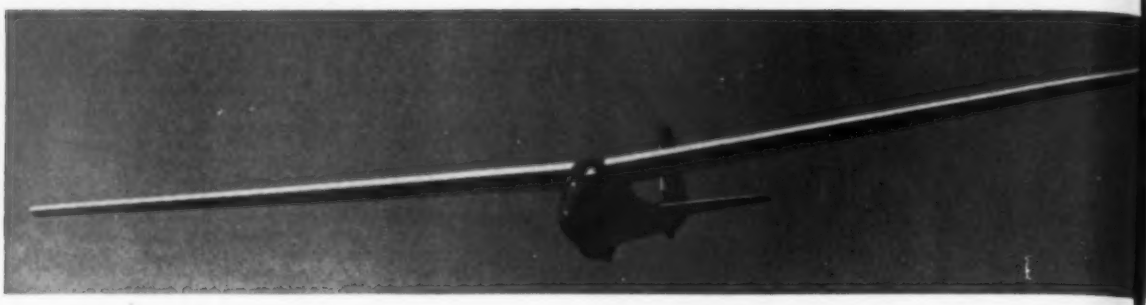
Trophy for the best combination of cheapness, simplicity and efficiency. The Bréguet 905 Fauvette, which made its début at Leszno, is to be flown this year by France, Israel and Switzerland; the Polish Mucha Standart has been entered by Belgium and Denmark; and two examples of a new Austrian machine, the Austria Standard, and the Polish Foka will be seen for the first time this year.

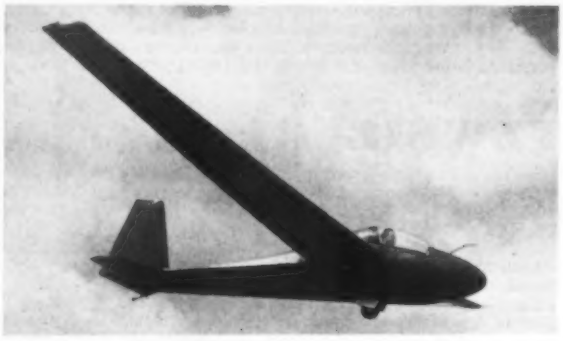
The championships will comprise a number of contest days, on each of which a set task will be specified for pilots in each class. Free distance (in any direction) and a goal race or out-and-return race are obligatory, while two further types of contest may optionally be set. These are distance along a specified direction, and triangular races over 100km (one or two laps), 200km or 300km. Launching of the gliders will be by Do.27 tug aircraft, and retrieving will be by road.

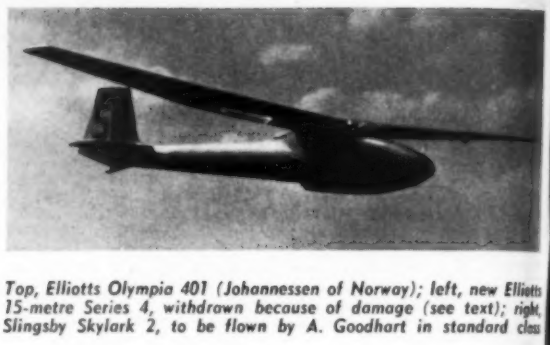
Following a decision taken at a meeting of the FAI Gliding Commission in Paris last March, the championship rules state: "The organizer is authorized to prescribe a maximum flight altitude for the contest day, if flight safety makes it necessary." Any pilot exceeding the prescribed maximum altitude would be excluded from the contest. This will be an extremely difficult rule to enforce, and presumably will mean that barograph records must be produced in order to "prove" that a pilot has not exceeded the height limit. The restriction on height is in effect a prohibition of cloud flying—"if flight safety makes it necessary."

Butzweiler Airfield is located in the Rhine valley about five miles north-west of the City of Cologne. The terrain west and north of the city is mainly flat, with higher ground to the east and south. Some 6-12 miles south-east of Cologne is a ridge of hills lying along a north-west/south-east line. The type of weather in this area is influenced both by these hills and by the industrial "Ruhrgebeit" or Black Country, the western border of which lies about 30 miles north of Cologne.

The month of June produces, on average, good gliding conditions in this region. In weather situations with light winds good convection is found over the mountainous areas. With south-westerly winds thunderstorms are likely over the Eifel mountains 45 miles south of Cologne, together with severe downdraughts north







Top, Elliotts Olympia 401 (Johannessen of Norway); left, new Elliotts 15-metre Series 4, withdrawn because of damage (see text); right, Slingsby Skylark 2, to be flown by A. Goodhart in standard class

PROSPECTS FOR BUTZWEILER . . .

of these mountains. Westerly and northerly winds can accentuate the upcurrents on the northern side of the mountains, while with easterly winds convection in the Butzweiler area is reduced because of the influence of the mountains on this side of the city. A well-known local thermal area is the industrial region of Knapsack, south of the airfield, which is frequently marked by rising smoke and cumulus. In the early afternoon the base of the cumulus clouds is usually about 3,000-5,000ft, and a ceiling lower than 1,500ft is seldom experienced during summer. According to the German weather service, thunderstorms may be expected in the area of Cologne on four to five days during June, travelling from west-southwest.

The seventh congress of the international gliding research organization OSTIV (Organisation Scientifique et Technique Internationale du Vol à Voile) will be held in Cologne during the period of the championships. The opening of the congress will be on June 7 and the meeting will close on June 18, after a programme which includes technical and meteorological papers and a number of discussions on the proposed standard-class airworthiness requirements. Among the British papers to be presented will be a description by Peter Davy of the Crossfell variometer.

At the meeting the OSTIV prize will be presented to "the person who has made the most important technical or scientific advance in soaring flight" (first won by Dr J. P. Kuettner in 1958); and the OSTIV Trophy for the best standard class sailplane (as judged by a committee on the grounds of cheapness, simplicity and efficiency) will be awarded.

As in previous years, support for the British gliding team in the provision of equipment has come from a number of manufacturers. Each of the sailplanes is company-owned, the Skylarks by Slingsby Sailplanes and the Olympia 419 by Elliotts of Newbury; and the retrieving vehicles, almost as important as the aircraft themselves in any championship meeting, are again Vanguard estate cars loaned by the Standard Motor Co. Radio equipment has been supplied by Pye, maps and motor oil by Shell-BP, further maps by Esso, batteries and torches by Ever Ready, route facilities by the Automobile Association and inflatable beds by B. P. Cow and Co. Among the donations to the championships funds is one of £750 from the Society of British Aircraft Constructors.

For the first time since the birth of world contest gliding in 1937, the British team does not include Philip Wills, who announced his decision to retire from international contest flying last year. Winner of the 1952 World Championships in Spain, runner-up to Gerard Pierre in 1954, chairman of the British Gliding Association and author of the classic introduction to gliding *On Being a Bird*, Philip Wills has well-earned his place as the premier pundit of British gliding.

It is invariably difficult to forecast the result of any gliding contest, and with the great variety of sailplanes entered for the standard class in particular it is exceptionally hard to say in advance who will become the World Champion at Butzweiler. In the open class Nicholas Goodhart and Deane-Drummond have good chances of achieving high placings, particularly if the weather during the contest period is difficult in the British manner. Goodhart won the two-seater class of the 1956 championships at St Yan, and came second to Haase in the open class in 1958. On the latter occasion he was flying his own Skylark 3B; the Olympia 419 is Britain's highest performance sailplane at the present time, and our chances of regaining a world-champion title have never been better.

In gliding as in other sports, however, it is indeed tough at the top, and there are several formidable contenders from other countries. The present champion Haase, flying the new Phönix over home ground, is probably the favourite, while the Polish Zefirs flown by Makula and Popiel should also do well. Other high-performance entries include the RHJ-6 which designer/pilot Richard Johnson is bringing from the USA; the Czecho-

Two high-performance open-class entries are the Czech Spartak and (right) the Yugoslav Meteor 57

French entry in the standard class is the Breguet 905 Fauvette

PROSPECTS FOR BUTZWEILER . . .

slovak Spartak, seen at Leszno; and the now-familiar but still exotic Meteors flown by Komac and Mrak of Yugoslavia. At the other end of the scale is the Weihe, a pre-war German design which has continued to surprise many people with its performance in post-war championships. This year an example of this type is being flown in the open class by Bernhard Müller of Switzerland.

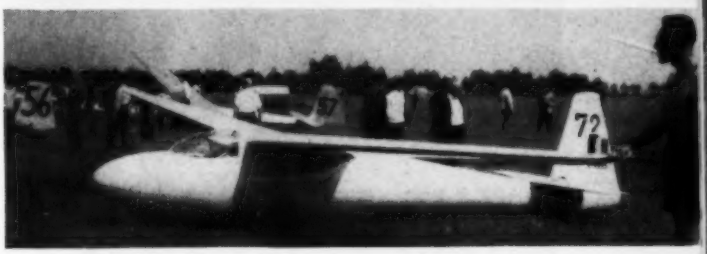
Illustrated reports of the championships by Kenneth Owen of *Flight* will appear in our issues of June 17 and 24 and July 1.

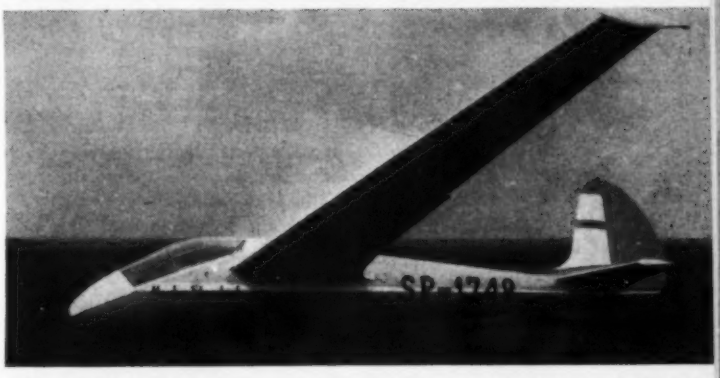
1960 WORLD GLIDING CHAMPIONSHIPS: OPEN CLASS ENTRIES

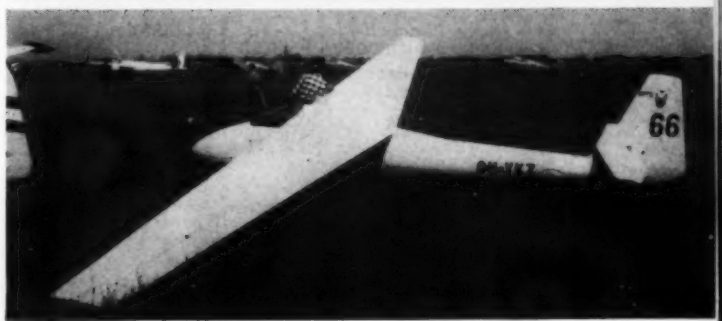
No	Pilot	Country	Sailplane
1	Toni Gaze	Australia	Skylark 3
2	Harald Jansen	Denmark	Skykrafter
3	Ernst-Günter Haase	Germany	Phönix
4	Harald Tandefelt	Finland	Ka 6CR
5	Camille Labar	France	Breguet 901
6	Anthony Deane-Drummond	Gt Britain	Skylark 3F
7	Nicholas Goodhart	Gt Britain	Olympia 419
8	Fritz Seyffert	Holland	Skylark 3
9	Guido Antonio Ferrari	Italy	Skylark
10	Menahem Bar	Israel	Zugvogel 3
11	Isamu Oda	Japan	Zugvogel 3
12	Bozidar Komac	Yugoslavia	Meteor 57
13	Joze Mrak	Yugoslavia	Meteor 57
14	Edward Makula	Poland	Zefir
15	Jerzy Popiel	Poland	Zefir
16	Sven Ingvar Jonsson	Sweden	Zugvogel 4
17	Rene Comte	Switzerland	Elfe
18	Bernhard Müller	Switzerland	Weihe
19	Vaclav Marecek	Czechoslovakia	Demant
20	Vladislav Zejda	Czechoslovakia	Spartak
21	Viatcheslav Efimenko	USSR	A-15
22	Mikhail Veretennikov	USSR	A-15
23	Nandor Opitz	Hungary	Gyor 2
24	Richard Johnson	USA	RHJ-6
25	Richard Schreder	USA	Air-Mate HP 9
26	Jose Ortner	Argentine	Skylark 3
27	Rudolfo Hossinger	Argentine	Skylark 3

STANDARD CLASS ENTRIES

No	Pilot	Country	Sailplane
31	Robert Rowe	Australia	Ka 6
32	Jean d'Otreppe de Bouvette	Belgium	Mucha Standart
33	André Xhaet	Belgium	Ka 6B
34	George Münch	Brazil	Ka 6
35	Claudio Junqueira	Brazil	Ka 6
36	Gordon Oates	Canada	Ka 6
37	Jorgen Friis	Denmark	Mucha Standart
38	Niels Sejstrup	Denmark	Ka 6BR
39	Hans Böttcher	Germany	Ka 6BR
40	Heinz Huth	Germany	Ka 6BR
41	Jorma Jalkanen	Finland	Pik-3C
42	Olavi Rautio	Finland	Pik-3C
43	Daniel Barbera	France	Breguet 905
44	Jacques Lacheny	France	Breguet 905
45	Anthony Goodhart	Gt Britain	Skylark 2
46	Sipko Andreae	Holland	Ka 6
47	Willem Toutenhoofd	Holland	Ka 6
48	Leonardo Brigliadori	Italy	E/C 39
49	Giancarlo Silva	Italy	M-100S
50	Porhallur Filippusson	Iceland	Ka 6
51	Dany Arbar	Israel	Breguet 905
52	Amos Jardeny	Israel	Breguet 905
53	Emil Korsic	Yugoslavia	Ilindenka
54	E. Backe-Mathisen	Norway	Zugvogel 4
55	Tor Johannessen	Norway	Olympia 401
56	Johann Fritz	Austria	Austria-Standard
57	Hans Resch	Austria	Austria-Standard
58	Adam Witek	Poland	Foka
59	Miguel Ara	Spain	Ka 6
60	Luis Juez	Spain	Ka 6
61	Per-Axel Persson	Sweden	Zugvogel 4A
62	Irvo Silesmo	Sweden	Ka 6BR
63	Alex Gründisch	Switzerland	Breguet 905
64	James Harrold	S Rhodesia	Ka 6
65	Rudolf Mestan	Czechoslovakia	Standard
66	Victor Iljtchenko	USSR	Standard
67	Ernö Kisely	Hungary	Standard Futar
68	Ernö Mandl	Hungary	Junius 182
69	Paul Bikle	USA	SGS-1-23H
70	Julio Arteman	Argentine	Skylark 2







Other foreign standard-class sailplanes (from the top): Ka 6B, Germany; Standard Futar, Hungary; Ilindenka, Yugoslavia; Mucha Standart, Poland; and Pik-3C, Finland

Lord Portal

Sir Charles Dunphie

Hon George Nelson

THE BAC BOARD APPOINTMENTS

IN a brief reference last week to the British Aircraft Corporation, the composition of whose board was announced as we were going to press, names of the chairman and deputy chairmen were given; mention was also made of the acquisition by BAC of a controlling interest in Hunting Aircraft Ltd, and of the reconstitution of the English Electric Aviation and Vickers-Armstrongs (Aircraft) boards. It is now possible to give full details of these changes.

The Corporation has been formed by Vickers Ltd, the English Electric Co Ltd and the Bristol Aeroplane Co Ltd to bring together their respective aircraft and guided-weapon interests. At present it has a nominal capital of only £100; but after June 18, when legal and financial formalities have been completed, it will have resources of £20m. Of this sum, £8m is being provided by Vickers and a similar sum by English Electric, Bristol contributing £4m. The acquisition of Hunting Aircraft means that this company now becomes an operating subsidiary of BAC, with Vickers-Armstrongs (Aircraft) Ltd, English Electric Aviation Ltd and Bristol Aircraft Ltd.

The first directors of the BAC, and the directors of the reconstituted boards of English Electric Aviation and of Vickers-Armstrongs (Aircraft), are listed below; and details are also given of organizational changes in the Vickers Group.

Sir R. Verdon Smith

Lord Caldecote

Sir George Edwards

British Aircraft Corporation

Marshal of the RAF Viscount Portal of Hungerford (chairman); Maj-Gen Sir Charles A. L. Dunphie and the Hon George Nelson (deputy chairmen); Sir Reginald Verdon Smith; Rt Hon Viscount Caldecote (executive director, guided weapons); Sir George R. Edwards (executive director, aircraft); W. Masterton (financial director); G. A. Riddell; and R. P. H. Yapp. The company secretary will be J. O. Charlton.

Sir George Edwards and Lord Caldecote will be responsible to the BAC board for the direction of aircraft and guided weapon policy respectively and for the allocation of capacity and priorities. Lord Caldecote, Sir George and Mr Masterton retain their existing directorships in the English Electric Co Ltd, Vickers Ltd and the Bristol Aeroplane Co Ltd respectively.

W. Masterton

G. A. Riddell

R. P. H. Yapp

English Electric Aviation

Hon George Nelson (chairman); Viscount Caldecote (managing director); L. H. Bedford (director of engineering, guided weapons division; R. F. Creasey (director of engineering, aircraft division); Air Cdre S. Graham (commercial director, aircraft division); G. R. Jefferson (chief engineer, guided weapons division); F. W. Page (chief executive, aircraft division); and A. T. Slator (manager, guided weapons division). In addition Wg Cdr R. P. Beamont, manager flight operations and chief test pilot, is appointed a special director.

Lord Nelson of Stafford, Sir Archibald Forbes and Sir John Woods retire from the board; Sir Conrad Collier retires from the position of chief executive, guided weapons division, and also from the board; and Viscount Caldecote (formerly deputy managing director) will in his capacity as managing director also act as chief executive, guided weapons division.

L. H. Bedford

R. F. Creasey

G. R. Jefferson

Vickers-Armstrongs (Aircraft)

Maj-Gen Sir Charles Dunphie (chairman); Sir George Edwards (managing director); T. Gammon (deputy managing director); A. W. E. Houghton (general manager); J. E. Armitage (commercial director); H. H. Gardner (technical director); A. H. C. Greenwood (director, sales and service); G. F. H. Hemsley (chief engineer, aircraft); and B. E. Stephenson (director of engineering).

Arising out of the Bristol/English Electric/Vickers merger, the following organizational changes have been announced by the Vickers Group:—

Vickers-Armstrongs Ltd. A. O. Bluth, Sir George Edwards and T. Gammon will resign from the board with effect from June 16. Mr Bluth and Sir George, who are directors of Vickers Ltd, will remain on the board of that company.

Vickers-Armstrongs (South Marston) Ltd. The South Marston works of Vickers-Armstrongs (Aircraft) Ltd is being excluded from the merger and on June 16 will be taken over by Vickers-Armstrongs (South Marston) Ltd, which has been formed for this purpose, with the following board: W. D. Opher (chairman); S. P. Woodley (general manager) and J. H. Robbie.

Vickers (Aviation) Ltd. Vickers Ltd state that as already announced, financial responsibility for types of aircraft and missiles already in production will remain with the appropriate principal company. As regards Vickers Ltd, this responsibility will be operated through Vickers (Aviation) Ltd, which has been dormant since 1938 when the aircraft interests of Vickers were transferred to Vickers-Armstrongs Ltd. The board of Vickers (Aviation) Ltd will be: R. P. H. Yapp (chairman); N. H. Jackson; J. H. Robbie; and Sir Leslie Rowan. The secretary of both Vickers-Armstrongs (South Marston) Ltd and Vickers (Aviation) Ltd is H. E. Scrope and the registered offices are at Vickers House, Broadway, Westminster, London SW1.

F. W. Page

A. T. Slator

Wg Cdr R. P. Beamont

H. H. Gardner

G. F. H. Hemsley

B. E. Stephenson

FLIGHT SYSTEM SURVEY

NATO Decca Trials

FOLLOWING initial trials with a Fiat G.91 in Britain last year, tactical Decca navigation has been tested more extensively with a specially installed chain in the Rome area. The installation was made at the request of SHAPE and three aircraft, a G.91R and two F-100Fs, were fitted with a special lightweight Decca receiver. The chain was also used in Decca's Viking for a very successful demonstration for the civil air traffic control authorities.

American, British and Italian air force pilots completed a considerable number of simulated strike sorties in the military aircraft, attacking a wide variety of targets in many types of terrain and often in poor weather. It is claimed that the pilots considered that, with the help of Decca, they could make accurate attacks in ceilings as low as 500ft and visibility of ¼ mile or less. GCA approaches were made at the end of each sortie and, with Decca, the main weather limitation is reported to have been altimeter inaccuracy. The official report on the trials is yet to be issued.

More CMC Doppler

AN order for eight CMA-601 navigation computers and for a further four Doppler radars has been placed with the Canadian Marconi Co by KLM. This airline's initial DC-8 was the first production example of the type to be delivered from the Douglas factory with a complete and operational Doppler radar. The CMA-623 Doppler was in fact used throughout transatlantic delivery flight to Amsterdam.

BMEWS in Britain

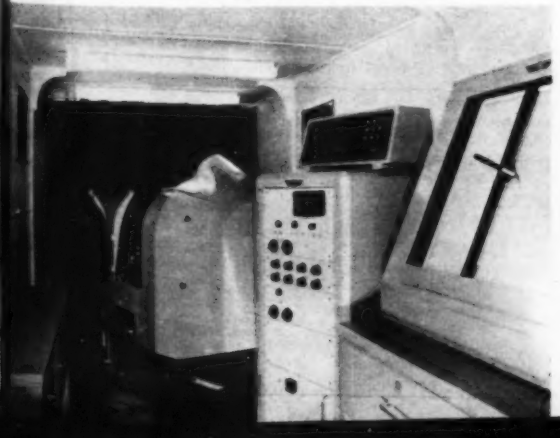
ACCORDING to recent advertisements in the press RCA Great Britain Ltd are seeking to recruit 450 men of all grades for the installation, evaluation, operation and maintenance of the British ballistic missile early-warning system to be constructed at Fylingdales Moor. The first group of senior technicians are to be trained at the RCA missile and surface radar division at Moorestown, NJ, and will subsequently work at Sunbury-on-Thames and Fylingdales Moor. The British contribution to the cost of this BMEWS station is £43m.

The Bendix Corporation

FROM June 1, Bendix Aviation Corporation has changed its name to the Bendix Corporation. Under its new title the company "hopes to project the broad and continually expanding diversity of its activities in a clearer picture to the country's business, industrial and financial communities, to its government customers and to the general public." Automotive and aviation work accounted for 65 per cent of the corporation's business during 1959, but Bendix feel that the name should also relate to its work in the fields of electronics, missile and space vehicle equipment and nuclear engineering.

Field Aircraft Services Ltd at London Airport are United Kingdom distributors and service representatives for the following Bendix divisions: Bendix Products, Indiana; Bendix Radio, Baltimore; Bendix Filter, Michigan; Bendix Eclipse-Pioneer, New Jersey; Bendix Pioneer-Central, Iowa; Bendix Red-Bank, New Jersey; Bendix Utica, New York; Bendix Pacific, North Hollywood; and Bendix Cincinnati, Ohio. Certain Bendix products are also manufactured under licence in Britain by Elliott Brothers (London) Ltd.

Automatic radio aids and a Link trainer in General Precision System's demonstration trailer. (See news-item in Col. 2)



The US Army's new ruby maser unit and its liquid-helium tank, described immediately below

Cold Crystal

ILLUSTRATED above is a new US Army ruby maser unit for a radar or communications receiver in X-band using K-band pumping. The cryostat containing the maser is at the lower end of the waveguide and the tank at the right contains liquid helium which cools the unit to about 5°K. Tests are now in progress at the US Army Signal Research and Development Laboratory.

Link Trainer Sales Tour

ALREADY well advanced is a European sales tour by a mobile caravan unit of General Precision Systems Ltd containing a single-seat Link Trainer equipped with a four-station automatic radio aids unit. The radio aids can be added to the standard Link trainer to simulate automatically all up-to-date radio navigation facilities.

Solid-State Analogue Computer

THE research division of Servomechanisms Inc has completed initial trials of a solid-state analogue computer which has no moving parts. The components consist of vacuum-deposited material which, according to the manufacturers, has sufficient versatility to simulate the components of the standard analogue computers and has the same input and output requirements as the costly precision geared units generally used at present. The solid-state units could be applied to airborne and space vehicles and, Servomechanisms claim, will eventually take the place of present units.

An ADF Director Instrument

A DIRECTOR cross-pointer presentation has now been developed by Aircraft Radio Corporation for use with MF beacons and ranges. The course director itself consists of cross-pointers within a circular compass display which is in fact a modification of the standard VHF director formerly produced by the company for VOR and ILS flying. These functions it can still perform, but now added is a special computer with its own compass unit and slaved directional gyro and a computer for ADF bearings. It is now possible to select an inbound or outbound bearing to be flown in relation to an NDB or range station and to obtain needle-central guidance to that radial and subsequently along it by the indications of the vertical cross-pointer needle. The components of the CD-4, as it is called, together weigh 18.2lb and 5lb of this is accounted for by the directional gyro. Failure of the MF course computer will not interrupt the operation of the VHF section. According to *Aviation Week*, the ARC system is to be placed on the commercial market in July at a cost of $3,200.

ARC originally developed the CD-4 to a US Army requirement for tactical use of NDBs by low-flying light aircraft. They claim that the system might also be useful for helicopters flying in either open or built-up areas. The US Army Aviation Board has completed a fixed-wing evaluation at Fort Rucker and environmental testing is in hand.

F

First comes the waiting. At the end of the tele-scramble lead is a Lightning of Air Fighting Development Squadron; its pilot is thus in direct contact with the control centre many miles away

The dark hours are the longest. Javelin of No 72 Sqn silhouetted against a dispersal floodlight

BATTLE OF WIT

GORDON HORNER Flew in Exer Yeoman and Recorded his Impressions i these Sketches and Captions

(Code-named "Yeoman" this year, the annual UK defence exercise took place during the period May 1 As related in our last issue, Fighter Command wa readiness for a whole week; in the words of the Ministry, "it had never before imposed upon itself s a severe test for so long a period." Typical of t exercise were the activities of RAF Leconfield, wh these impressions were obtained.)

"23 airborne!" Taking-off in a Hunter T.7 flown by Flt Lt J. A. Bell, we head north-east and find (below) cloud almost touching the cliffs near Flamborough Head

A Javelin climbs through the low cloud to an interception over the North Sea

"Maintain heading two four zero and over to GCA." Sqn Ldr J. H. J. Merriman, in approach control, recovering Javelins from the murk

"Scramble!" Hunters of No 19 Sqn claw skyward on their first sortie of the exercise, Friday, May 20

...tion completed: a Lightning jettisons its braking 'chute on return to Leconfield

Straight and Level

LAST week Sir Charles Boost, prince of British air power, invited me to his Belgravia mews flat for a drink and a chat about the chairmanship of BOAC. Sir Charles is part-time chairman and part-time chief executive of Plummet Air Lines.

"If you want my candid opinion, old boy," he said, lovingly spinning the wheels of the S.E.5 that hangs from the ceiling of his drawing room, "the last man we want is someone with an airline background. Masefield? He's too much of an air transport man. No, we want an Establishment figurehead with wide non-aviation interests, someone with plenty of strings to pull in Whitehall when things go wrong—you know, a chap who has a way with people, eh laddie? . . ."

". . . But Boostie, BOAC deserves better than that. Think what such an appointment would do to staff morale. Smallpeice has got a good team going now, and . . ."

". . . Fiddlesticks, old boy, and raspberries," he retorted, kicking his labrador, Blue Streak, off the delta-wing steel sofa. "BOAC's job is to show the flag and to get a supersonic plasma jet airliner into service next year. It's a State-owned prestige outfit, not an airline. As usual, my dear fellow, you've got it all wrong, all wrong. Have another drink."

● Did you read in the papers last week accounts of the extent to which take-offs are being delayed by heavy traffic? At New York recently a BOAC 707-420 burned off two tons of fuel before it was cleared to take off, and it very nearly had to return to the ramp for refuelling.

On the morning of May 10 a colleague flew from the same airport to Philadelphia by American Airlines DC-6. The aircraft taxied away from the ramp right on schedule at 10.10hr local time. It was in the queue for just over 25min. My colleague jotted down his observations as follows:

"American Airlines Convair 340 in front of us. TWA 707 takes off. UAL DC-8 lands. American Airlines DC-7 behind us. BOAC 707-420 takes off. MATS Provider lands. Unidentified Convair 340 takes off. Piper Aztec executive lands. Eastern DC-7B taxies in. TWA Super-G Constellation taxies out. Delta DC-8 takes off. Unidentified DC-6 or DC-7 takes off. BWIA Viscount takes off. New York Airways Vertol 44 takes off [from the terminal area]. Eastern DC-7 takes off. Eastern 340 takes off."

This, he gathered, was quite routine. It was just bad luck that he should have been on the approach to Philadelphia when he was taking off from New York.

● "The aircraft is supplied with a set of indispensable tools"—from the Polish PZL-102 Kos brochure.

● You may recall my plea last week that the Ministry should try to make the London Airport shantytown a friendlier place. A colleague who last week passed through Hamburg airport tells me that prominently displayed there are big notices addressed:—

"Dear passenger: Our terminal has become too small and we are extending it for your better convenience. Please bear with us during the rebuilding and excuse some inconveniences. We are building you a really nice terminal to make your visit more agreeable and we are doing it as quickly as we possibly can."

● The president of Eastern Air Lines, disclaiming Eastern's interest in the Caravelle, says: "Here is an airplane built in a foreign land 4,000 miles away. We have trouble enough with people on our own doorstep, service-wise and otherwise."

One assumes that Eddie Rickenbacker says this in the knowledge that Douglas are supporting US domestic Caravelle operations, and that Douglas are also jointly developing the aircraft with Sud Aviation. (A new version, the Caravelle 14, with RB.141/11As, is being planned to cruise at Mach .84.) But his remark does seem to emphasize the main obstacle to extensive sales of foreign aircraft in the US market, no matter how good they may be technically.

Can it thus be assumed that there is substance in reports of DH efforts to obtain an American manufacturer's support for the D.H.121? The effort is well worth making. Not only Douglas but Boeing also (with the 727) and Convair (with the Model 60) are preparing to repel the D.H.121.

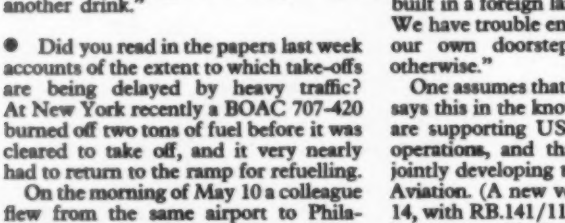
Passing thought: Is there really room for four contenders in the short-haul jet market (five if you include the German HFB314 project)? It seems to me that there is not. And it also seems fair to say that DH have at least as much to offer as they have to gain from an Anglo-American 121 programme. The aircraft has advanced some way beyond the brochure status of its competitors. It is in production. For the first time since the Viscount and the Comet 1 we have an airliner that is in advance of its US competitors.

The original caption says that these sportsmen, on the wing of a DC-7C, are "members of the KLM Airliner Fencing Club, and this is one way of attracting members." I should have thought myself that a spirited bout of thrust and parry round the polished contours of a NACA 23014 wing section, twelve feet above the Schiphol concrete, would be a particularly effective method of getting rid of existing members. Anyway, in this sort of boundary-layer fencing, blade-stall must cause a serious falling-off in thrust. Moreover, the employment of such flexible aero foils must make some form of duel control an absolute necessity.

The most anomalous vestigial remain of the old aircraft industry is the Aircraft Manufacturing Company. Airco, a consortium of de Havilland Aircraft, Fairey and Hunting Aircraft, was formed in January 1958 to build the D.H.121. But it is now confirmed that Hunting are part of the British Aircraft Corporation, so it seems that Airco has a foot in each of Britain's three airframe camps—D.H. in Hawker Siddeley (to be called Hawker de Havilland?), Fairey in the Westland helicopter group, and Hunting in BAC. The fact that Fairey is part of Westland may not prove too awkward; but Hunting's membership of BAC may strain its allegiance to Airco if BAC goes ahead with the VC11.

● A certain well-known aeronautical librarian was asked the other day for the date and place of the Wrights' first flight. Having supplied the answer, he tells me, he was "somewhat taken aback" to be further asked: "Where did they finish?"

ROGER BACON



A reader sends me this postcard from Prestwick, entitled "Floral Picture, Belleisle Park, Ayr" with the comment: "I believe Pan American pay a man to keep this garden in good condition."

AVRO 748

By Bailey Bond, Bsc, Dip. AFRAeS

Conventional yet Different; New yet Well-proven

WHEN A. V. Roe & Co Ltd announced last year that they were re-entering the civil market with a twin-Dart feeder-liner as a DC-3 replacement, the aeronautical world as a whole was surprised. The Avro 748 seemed late in the day, when aircraft such as the Friendship and Herald had already built up flying hours—and, in the case of the Friendship, been delivered to many customers. A good deal of pessimism was heard concerning the prospects of the project, which subsequent events have shown to have been unfounded.

No less than 12 months before the maiden flight [expected this month] the 748's commercial career had begun with a licence agreement with the Indian government. Manufacture in India as a general-purpose transport for the IAF is already under way, and an Avro team is advising the Indian constructors. At home, Skyways have three on order, and BKS have ordered two with an option on three more. Both operators hope to be flying holidaymakers across the Channel in the new aircraft by the summer of next year. More recently, three of the higher powered Series 2s have been ordered by BOAC for Aden Airways.

Avro believe that their late entry into the race has been to their advantage rather than otherwise. They have been able to profit from the experience of others; and the 748 is coming to fruition at a time when the operators of the 1,590-odd DC-3 and Dakota aircraft still in service are beginning to realize that time is gradually running out. Their re-entry into the transport field was dictated largely by the cancellation of the 720 intercepter and the 730 supersonic bomber in 1957, and the fact that Shackleton production was coming to an end. It was essential to find alternatives to keep the works occupied. They made an intensive study of the needs of the civil market, and came to the conclusion that there was a prospect for a really inexpensive short-haul feeder liner.

Their first thoughts were centred around the various interesting new turboprops in the 1,000 h.p. class that were coming along, two of which would be used in an aircraft with a gross weight of the order of 20,000lb. But a preliminary survey revealed that many DC-3 operators operate under quite primitive conditions and were reluctant to undertake the initiation of new types of powerplant. They wanted well-proven engines—Rolls-Royce Darts. So Avro planned a larger aircraft, weighing about 27,000lb, which they proposed to power with 1,400 h.p. Dart RDa.3s. These engines were available secondhand in considerable quantities, and Avro felt that their use would make for a very attractive selling price. However, before embarking on the project they deemed it advisable to undertake a more detailed world-wide market survey. This showed that DC-3 operators really were very interested in a twin-Dart aircraft that could be offered at a substantially lower price than its competitors; but they wanted something rather bigger, with the 1,600 s.h.p. RDa.6. Most operators were interested primarily in sector distances of the order of 200 n.m.

Thus, under the leadership of Avro's chief designer, J. R. Ewans, and the Avro 748 project designer, R. Connor, the Avro 748 Series 1 began to take shape. Powered by two Rolls-Royce Dart RDa.6 engines, it is designed to carry a full payload of 40/44 passengers, their baggage and some freight (totalling 9,666lb) over stage distances of 200-400 n.m., at a cruising speed of 230kt. Gross weight is 33,000lb. As it will have to operate from small airfields—often from grass—it had to have a take-off and landing performance at least as good as that of the aircraft it was replacing. Hence the adoption of a high aspect ratio (11.35), large propellers (12ft diameter), a low wing loading (41.5lb/sq ft) and large Fowler flaps extending over 58.2 per cent of the span. For satisfactory operation from primitive airfields, tyre pressures are low, and a generous 2ft propeller clearance has been provided by mounting the engines above the wing. The ground angle is considerable to give plenty of clearance under the rear fuselage.

While the 200 n.m. stage is admirably satisfied by the Series 1 aircraft, the market survey showed that certain operators, notably in Africa, were flying from primitive "hot and high" airfields where greater power would be an advantage; moreover, some of these inland airfields were without fuelling facilities so that the aircraft would be required to fly several sectors on one fuel load. Accordingly Avro proposed the 36,000lb 748 Series 2, with a structure strengthened to permit full payload to be carried over 800 n.m., and with 1,910 s.h.p. RDa.7 engines to give extra power for take-off (also providing an increased cruising speed).

The Series 2 will probably cost about £30,000 more than the Series 1, but this does not mean that it is intrinsically an *improved* aeroplane. Except for operators who need the extra power or range, the Series 1 is the better answer, R.Da.6 engines having the advantage of a longer build-up of experience and a superb 2,500hr overhaul period.

In contrast to the Friendship and Herald the Avro 748 is a low-wing aeroplane. Although many passengers like the good view from a high-wing machine, operators generally prefer a low-wing, since it gives a cabin uninterrupted by wing structure, makes for easier access to control runs and "plumbing," reduces weight and volume of the undercarriage, and is probably safer in a crash landing or in ditching. Moreover, several operators told Avro that they preferred the low-wing configuration simply from the point of view of appearance: they felt that, in the case of a rather small machine, the low-wing airliner looks more like the "real thing" than does a high-wing aircraft!

Throughout its length the cabin is of constant circular section, facilitating quick changes of configuration from all-passenger to mixed passenger/freight traffic by the insertion of lightweight partitions at any desired station. In conformity with modern practice, the freight is carried forward of the passengers. The floor is stressed for freight at 75lb/sq ft all over, and 100lb/sq ft along the outer thirds, with the centre clear. An upward-hinging freight door 54×48in is provided to port at the forward end of the cabin. The main passenger entry door is at the aft end, port, and opposite to it is a baggage door, which, in the aft galley and toilet configuration that Avro suggest, would also be used for pantry servicing. All the main doors serve as emergency exits, and there are four additional emergency exits above the wing. For ultra-rapid turn-rounds, the freight door can be fitted with Airscalator steps for passengers, who can deposit their carry-on luggage in racks in the forward hold; the starboard engine can be kept running.

Apart from equipment—including the radio—carried on the flight deck, all main services are located under the cabin floor, accessible through quick-release skin panels at a convenient working height. The nose is hinged giving access to the batteries, and provision is made for fitting weather radar. In the starboard side of the nosewheel bay are grouped the main hydraulics; farther aft is the pressurizing and air-conditioning equipment, and still farther aft the main electrical bay. The wing-root fillets house water/methanol tanks (port and starboard), and the flap operating gear (starboard).

The entire aircraft has been carefully designed to give the

Men behind the 748: from the left, J. Rimington, chief development engineer; J. A. R. Kay, managing director; C. E. Fielding, works director; Sir William Farren, technical director; and S. G. Joy, general manager

"Flight" photograph

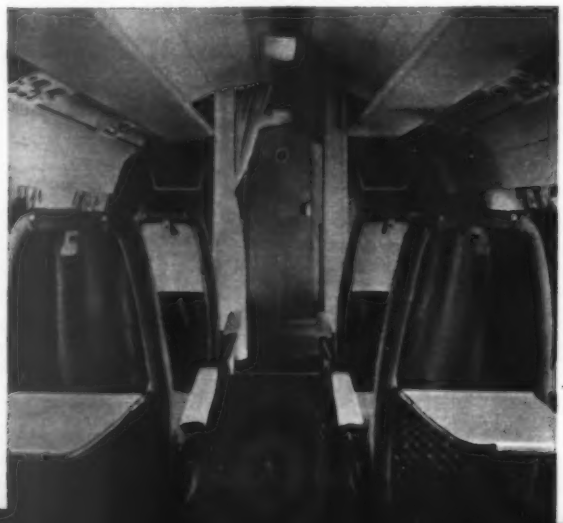
This photograph of the flight deck of the first Avro 748, G-APZV, reveals the uncluttered instrumentation and large forward windows

AVRO 748 . . .

utmost service with the minimum of repair and replacement. Common items are widely used: all fuselage and underwing inspection doors are interchangeable, as are the port and starboard halves of the tailplane, elevators and main undercarriage. In spite of its painstaking detail design the airframe is extremely simple, and all the systems are built up from well-proven components. The powerplants are Viscount 800 installations purchased from Vickers-Armstrongs. The Rotol propellers have the same type of blade as the Friendship, and hubs similar to those of the Argosy. Each accessory gearbox is a Viscount 800 Rotol unit, complete with Godfrey cabin blower, Rotax 6kW d.c. generator, Lockheed Mk 9 hydraulic pump, water/methanol pump and engine tachometer as on the Viscount, but with the addition of a 22kVA alternator for de-icing the windscreen, engine intakes and propellers. The Lockheed hydraulic system is largely built up from Viscount-type components, and so also is much of the electrical system, which is mainly by Rotax. In the air-conditioning system, most of the Normalair pressure controllers, valves, etc., are Vanguard components, while the Godfrey cabin blowers and Vokes filters and silencers are of Viscount type.

Wherever possible, controls are operated mechanically, and no part of the hydraulic system is in any way dependent on electrics.

As noted in our January 22 issue, the interior of the passenger cabin has been styled by Donald Diamond. All the interior furnishing can be quickly removed to provide access for structural inspection and passenger-service panels can be repositioned without tools. Conditioned air is taken in from the base of the recessed channel beneath each hat-rack, to be extracted through perforated grills near floor level



To avoid expensive replacement of major structural components, the entire airframe can be permanently repaired in the field with materials and tools readily available. Except on the wing upper skin, no countersunk rivets are used; and sandwich materials, metal bonding and spot-welding have been ruled out entirely, since these are not compatible with 100-per-cent visual inspection. Avro consider the latter to be an essential corollary of the fail-safe philosophy: if a component is not to be "lifed," it must be regularly and rigorously inspected for incipient corrosion or fatigue cracks, and so no boxed-in members or blind areas can be tolerated. Since Avro hope to sell the 748 in parts of the world where condensation and consequent corrosion can be severe, they have taken great care in the protection of all metal surfaces with Alocrom treatment and barrier coatings, and Thiokol sealing at all mating surfaces.

No high-strength zinc-aluminium or magnesium alloys are used in the construction of the 748; nothing but the traditional copper-aluminium alloys, which are known to be fairly consistent in their fatigue behaviour. Stress levels are kept low to limit the rate of crack spread, and to ensure that component fatigue life shall amount to at least 30,000 hours. However, as a result of the "fail-safe" properties designed into the structure—a minimum of concentrated load members, twinned and even quadrupled members to provide alternative load paths and obstacles to inhibit the spread of a crack—Avro claim that it should hardly ever be necessary to replace a primary structural component simply on a time-expired basis. Regular inspection and local repair should prolong the safe life for as long as the aircraft is commercially attractive. Avro believe that the structural weight penalty involved by such "belt and braces" technique will be amply outweighed by the greater reliability and reduced maintenance. It must be pointed out that there are certain joints, such as the pick-ups for the powerplant or undercarriage, where alternative load paths cannot yet be provided without prohibitive weight penalties. Again in the interests of weight saving, Avro have departed from fail-safe principles in the structure of the control surfaces, which are simple and not too costly to replace. But the control-surface attachments are duplicated: where the hinge brackets are fixed in the main structure, secondary rib booms are provided; and each hinge-pin is a hollow tube, through the bore of which runs a through-bolt, so that if the hinge-pin fails, the through-bolt will take over the job.

As already noted, concentrated loads are avoided and main structural joints reduced to a minimum. Accordingly the fuselage is built up as one complete assembly, and so are the outer wings (apart from detachable leading edges, flaps and ailerons). The wing extends right across the aircraft, the centre section and stub wings being built integrally with the fuselage. The centre section has additional reinforcement on the upper surface and forms a boundary to the pressurized fuselage. Front and rear pressure bulkheads are plane surfaces reinforced on both faces.

Basically the wing is a single-cell torsion box. Top and bottom skins carry the bending loads and are reinforced by closely spaced Z-section stringers with angle or built-up T-reinforcement at the web/skin joints. Skin thickness is stepped from 14 (root) to 18 s.w.g. (tip) on the lower skin, 10 to 16 s.w.g. on top. The lower tension-loaded skin is in four panels, butt-jointed spanwise, to prevent any possibility of a crack running right across the entire torsion box. Failure of one panel still leaves the wing with 80 per cent of its ultimate strength. For similar reasons, the front and rear webs of the torsion box are made in separate

(*Continued on reverse side of fold-out sheet*)

SOME 748 SUPPLIERS . . .

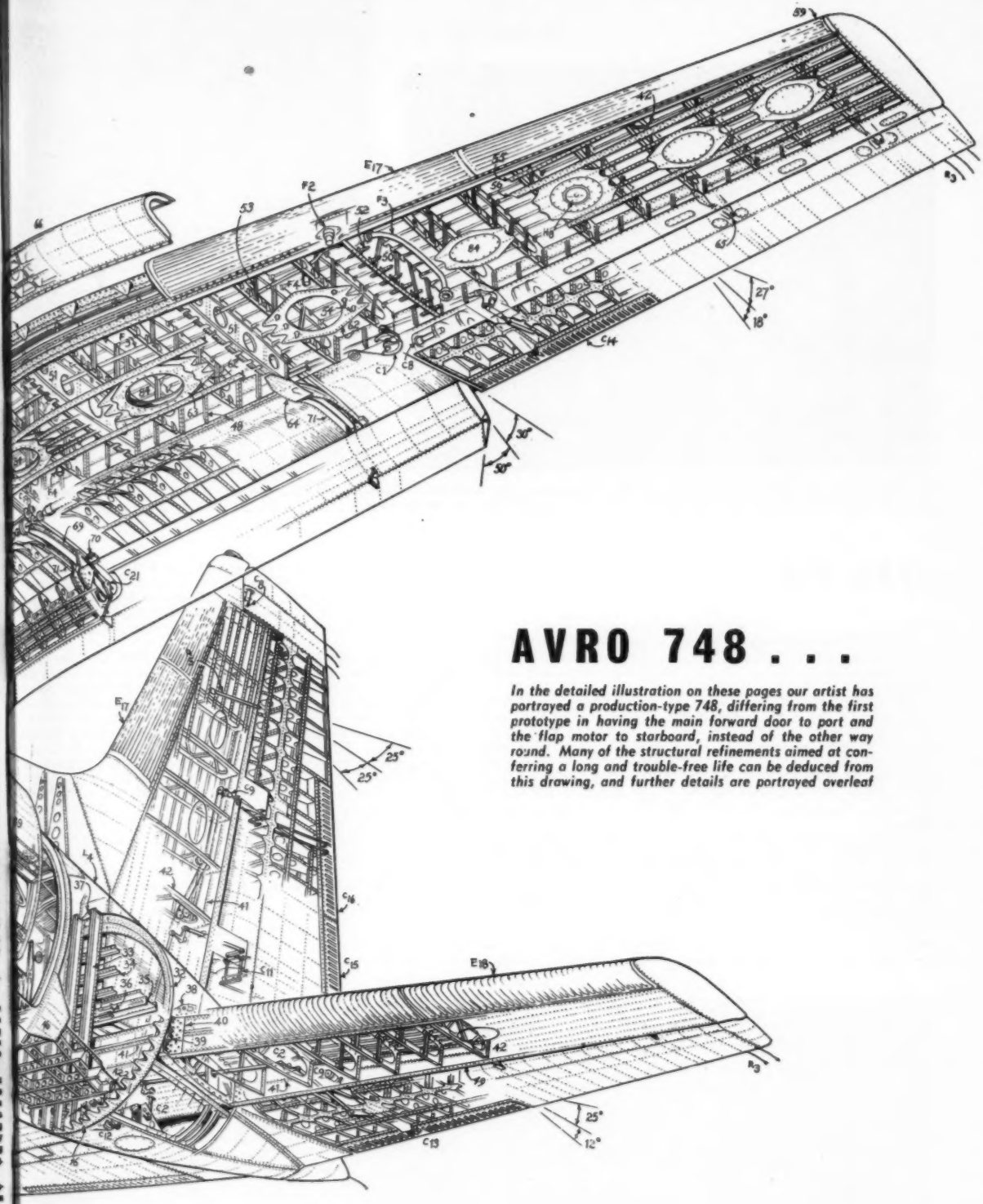
Airmed Ltd The crew positions on the flight deck are equipped with type RB1 oxygen masks made by Airmed to a specification by Avro. Used in conjunction with the well known Airlite telecommunication headset, with noise-cancelling boom microphone, this mask operates satisfactorily with a continuous oxygen flow of 1 to 3 litres/min at up to 25,000ft, or with increased emergency flow up to 30,000ft.

Dowty-Rotol This great West Country group provide some of the largest bought-out components of the 748. The complete undercarriage comprises three forwards-retracting units, each with oleo-pneumatic struts (extension 10.7in on main gear, 12.45/12.56in on nose) carrying twin wheels. The nose unit is hydraulically steerable through ± 45°, the steering system being centred during extension and retraction and switched off when the shock absorber is fully extended. The propellers are four-blade 12ft units, with a weight (including associated equipment) of 487lb; a three-line system is used, without reversing. Dowty-Rotol also provide the accessory gearboxes and drives.

Elliott Brothers (London) Ltd Although, as noted in the text, radio equipment will be furnished to customer requirement, Avro recommend the 21 Series communications and VOR/ILS equipment manufactured by Elliott Brothers (London) Ltd under licence to the Bendix Aviation Corp. This full airline dual VHF and single VOR/ILS system occupies little more than 20in of racking space and weighs only 75lb excluding cables. Elliotts have also supplied the complete interphone system, including special equipment for flight observers, and will deliver their new passenger-address system for the second prototype.

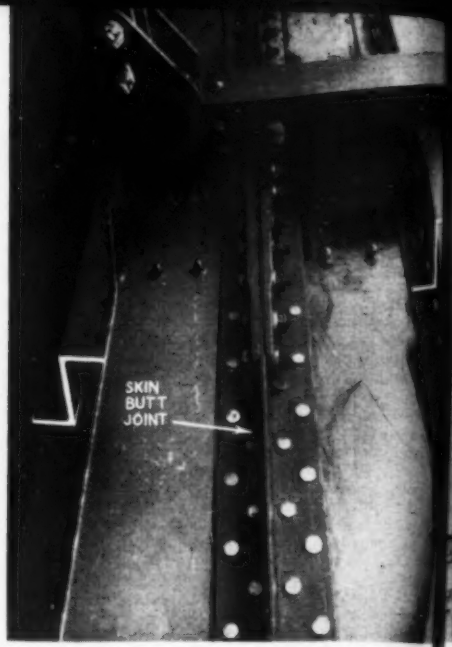
Normalair The pneumatic system for control of cabin atmosphere is similar to that developed for the Vanguard. The 748 system differs from that of the larger aircraft chiefly in that the settings can be controlled manually in flight. Teddington supply the temperature control valve.

Smiths Group Most 748s are likely to be equipped with the SEP.2 autopilot, and the aircraft has been designed for this installation from the outset. The s.s.i. altimeter, rate-of-climb and turn-and-slip indicators, E.2B stand-by compass and clock come from the group, together with virtually all the powerplant instrumentation and a long list of airframe instruments. In addition the aircraft is fitted with the Smiths Waymouth Type 2 compensated fuel-contents gauge.



AVRO 748 . . .

In the detailed illustration on these pages our artist has portrayed a production-type 748, differing from the first prototype in having the main forward door to port and the flap motor to starboard, instead of the other way round. Many of the structural refinements aimed at conferring a long and trouble-free life can be deduced from this drawing, and further details are portrayed overleaf



Avro have taken great pains to ensure that the 748 airframe will give a minimum of trouble, and to this end they have ensured that multiple load paths are used wherever possible. On the left above is a typical joint on a girder-type engine rib, while on the right is a stringer/rib junction

AVRO 748 . . .

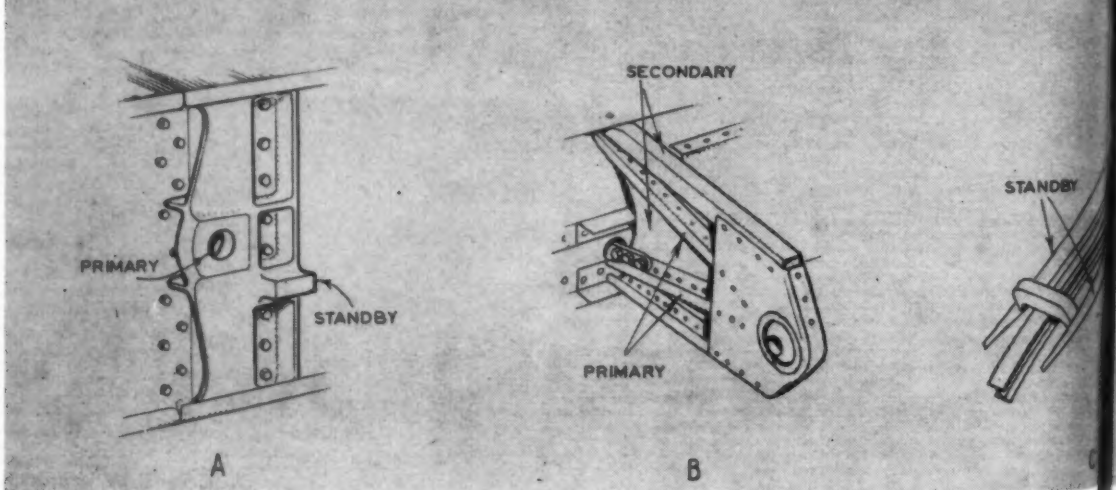
upper and lower portions, lap-jointed at about two-thirds of the depth, since cracks are most likely to occur under tension. Acting as a crack stopper, the lap joint is stiffened by a spanwise angle section.

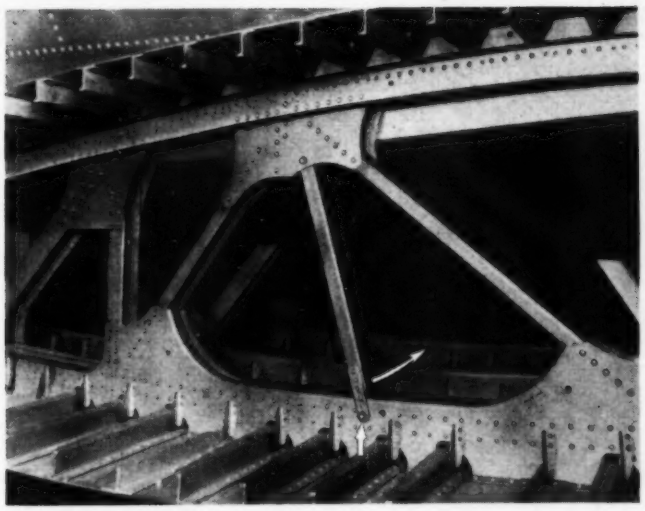
The ribs provide an excellent example of multiple-load-path construction. The two heaviest ribs in the outer wing are those carrying the main undercarriage pivots and engine mountings. Each is of girder construction with diagonals built up from four angle or channel-section members. Failure of any one section leaves the rib with 80 per cent of its design static strength. The main torsion box is uninterrupted by the nacelles, the engine mountings being above the wing and the undercarriage pivots below.

Fuselage structure comprises complete circular formers of channel section to which are cleated longitudinal stringers reinforcing the skin. Shear loads are transferred between the skin and formers by angle-section segments cut away at the stringers. At the main-spar stations are substantial frames each consisting of two complete angle-section circular formers extending to the skin. In the blending of the fuselage and centre section the continuity of both structures is preserved, making for an improved stress-distribution in a highly loaded region. Another example of fail-safe construction is the attachment of the tailplane and fin to the fuselage. Single-bolt attachments at each joint are reinforced by a keyway built into the fuselage fitting which mates with a tongue on the tail structure to act as a standby in the event of bolt failure. But perhaps the most intriguing of Avro's safety arrangements concerns the flaps.

Aerodynamically as well as functionally, the Fowler flaps are of unusual interest. Each includes a trailing-edge tab, linked to the roller carriage of the main portion. During the initial travel down to take-off deflection, where the objective is high lift combined with the lowest possible drag, flap and tab move as one unit. In the final movement to full landing deflection, where high lift and high drag are desirable, relative movement between the linkage and the roller carriage deflects the tab through 50°, although the main flap remains at only 30°. For optimum lift, it is desirable that the whole flap geometry, and particularly the gap between the wing trailing edge and the flap leading edge, should be constant along the span at all flap deflections. This is achieved by so arranging the four circular-arc flap tracks that all lie on a conical surface. Each track is supported at the rear spar of the wing torsion box. Additionally, ribs on either side of the track carry a bridge-piece which takes the load should the primary track support structure fail.

Flap operation is electric. A motor in the starboard wing drives through irreversible gearing, a torque-tube extending to the outboard end of each flap. Sprockets on this tube drive cables at each track position. To guard against failure of the primary torque-





A prerequisite to good airframe design is the ability to inspect everywhere Piercings in the reinforcing frame of the emergency exit enable the primary structure beneath to be seen, while the continuity between the fuselage and wing can be examined by undoing a single rib-strut bolt

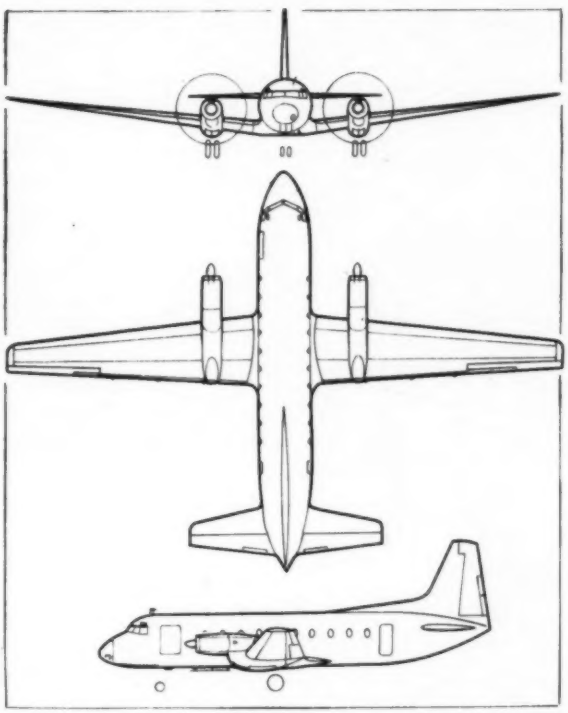
tube a secondary tube is arranged in parallel, with a chain drive from the primary at each end. If the flap motor should fail, the flaps can be operated manually.

Undercarriage arrangement is fairly orthodox. The three units are of British Messier design, hydraulically operated to fold forwards so that, in the event of hydraulic failure, gravity and air loads will bring the gear down after mechanical release of the uplocks. The doors are operated through mechanical links from the legs. Hydraulically operated Dunlop brakes and Maxaret units are fitted on the dual main wheels and the nose gear is hydraulically steerable. An emergency hand-operated hydraulic pump supplies the undercarriage jacks through separate pipelines from an independent reservoir. The main system operates at 2,500lb/sq in and is fed by the engine-driven Lockheed Mark 9 pumps.

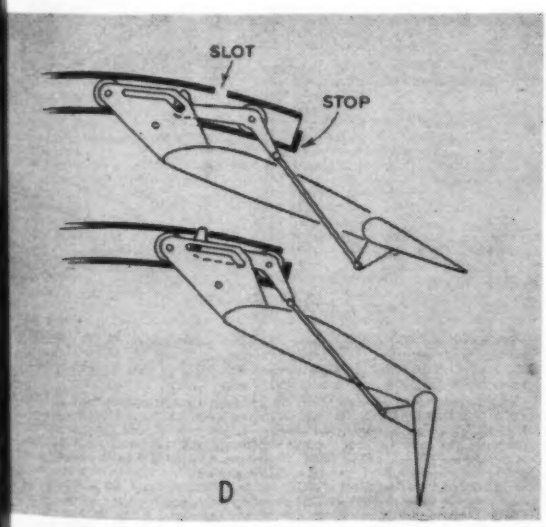
As already indicated, the systems generally are traditional. One noteworthy point concerns the flying controls, which are manually operated: the elevator trim-tab can be used to fly the aircraft in pitch should the main elevator-cable circuit fail. An automatic pilot—Smith SEP.2C, Sperry Gyropilot or Bendix PB-10A—can be fitted optionally. The second 748 prototype, which will be a demonstration aircraft, will be fitted with the SEP.2C.

Fuel is carried in two 570gal integral tanks in the outer-wing torsion boxes; large access holes in the lower wing skin, substantially reinforced on the inside, provide for inspection.

Each tank gravity-feeds into a small collector tank. Thence fuel is pumped to its own engine by two electrically driven SPE pumps—the "fail-safe" principle again, either pump being capable



Both the Series 1 and Series 2 aircraft are superficially identical, and the three-view drawing above is thus representative of both types



Drawings on the left illustrate details which give a clue to the philosophy followed throughout the airframe. A, the machined anchorage on the face of the tailplane spar is typical of empennage attachments. B, this aileron bracket is typical of control-surface hinges; through the Glacier dry bush passes a hinge-tube and central rod, to complete the duplication of load paths. C, a flap track, showing the support given by the flanking ribs. D, schematic operation of the flap tab

Structure
1 Front pressure bulkhead
2 Electrically heated gold-film windscreen
3 Forged windscreen frame
4 DV Panel
5 Pull-in-and-slide window
6 Heavy frames terminate at pressure floor
7 Pressure floor
8 Flight-deck floor
9 Heavy braced structure, supporting pressure floor and nose gear
10 Continuous Z-section stringers
11 Uncut frames
12 Frame/skin segment plates
13 Single-pressing door frames
14 Freight and crew door 48in × 54in
15 Spring-balanced door
16 Doubler plates
17 Stringers doubled up in this area
18 Window-retaining clamps (windows 19in by 13in)
19 Fabricated fuselage/wing main frames
20 Wing/fuselage joint (forging and plate, multi-bolt fixing)
21 Frames bolted to main ribs
22 Stringer carry-through fitting
23 Fuselage inter-spar skin support at ribs
24 Spars form pressure boundary
25 Top skin forms pressure boundary
26 Floor-support structure
27 Diagonals brace seat rails for axial loads
28 Honeycomb-sandwich floor panels (75lb/sq ft)
29 Passenger door 62in by 30in
30 Retracted airstairs (optional)
31 Stair-operating ram
32 Rear pressure bulkhead
33 Vertical stiffeners, front face
34 Horizontal stiffeners aft face
35 Heavy beam carries bottom fin fixing
36 Fin fixing (swing link)
37 Forward top fin fixing
38 Aft top fin fixing
39 Front tailplane fixing
40 Spar joint plate
41 Crack-limiting mid-web joint
42 Warren-braced ribs at hinges
43 Interchangeable tailplanes
44 Built-up fail-safe braces
45 Crack-limit joint at 67% depth
46 Double L-section bottom boom
47 Boom stabilizing brackets
48 Web stiffeners
49 Single L-section boom
50 Tank end ribs
51 Tank baffle ribs
52 Stringer carry through
53 Rib safe with any tie broken
54 Stringer/rib tie
55 Extruded Z-section
56 Extruded T-section
57 Skin in crack-limiting panels
58 Skin butt-joint
59 Tip NACA 4412; 18 swg bottom skin, 16 swg top.
60 Main root rib NACA 23018; 14 swg bottom skin, 10 swg top
61 Stringer joint plates
62 Stringer carry-through
63 Inspection-hole doubler
64 Doublers at flap tracks
65 Fail-safe hinge brackets
66 Detachable leading edge
67 Hinged leading edge
68 Leading edge fasteners
69 Flap track
70 Flap/rib bridge-piece
71 Ribs take load on track failure
72 Back-to-back channel section over skin
73 Back-to-back L-sections
74 Built-up fail-safe bracing
75 Hinged for flap access
76 Hinged nose (battery access)
77 Hinged fairing
78 Removable side and top panels
79 Outboard panels only shown—installations not handed
80 Cowling stays
81 Inspection, cabin air
82 Inspection, electrics bay
83 Inspection, tank and wing
84 Baggage and emergency door 25in by 49in
85 Main centre-section rib

Cabin-air system
1 Cooling-air intake
2 To cabin via non-return valve
3 Heat exchanger (normal system)
4 Heat exchanger (cold air system)
5 Cold-air unit
6 Water separator on delivery to riser
7 Cooling-air outlet
8 Pressure dump-valve (manual)
9 Temperature control valve
10 Cabin-air riser
11 Flight riser, radio cooling
12 Compressor to heat exchanger and temperature control
13 Heat exchanger to temperature control
A14 Compressor delivery silencer
A15 Non-return-valve
A16 Godfrey cabin-air blower
A17 Spill-valve and outlet
A18 Sensing and control unit
A19 Compressor flush intake
A20 Discharge valve (4.4lb/sq in)
A21 Discharge valve and inward venting
A22 Safety valve (4.7lb/sq in)
A23 Cabin-air distribution duct
A24 Circulation round wall before delivery to cabin
A25 Individual air louvres
A26 Extraction to below floor
A27 Compressor delivery

Controls
C1 Aileron controls
C2 Elevator controls
C3 Throttle
C4 H-P. cock and feathering
C5 Control rods under floor
C6 Cable tensioners
C7 Control-run pressure seal
C8 Mass balance
C9 Trim screwjack
C10 Duplicated control rods
C11 Torsion bars, rudder spring-tab
C12 Rudder control
C13 Geared servo
C14 Geared trim
C15 Spring-tab
C16 Trim
C17 Electric flap motor (manual emergency)
C18 Duplicated torque-tubes
C19 Interconnecting chain and sprockets
C20 Flap-operating cable
C21 Tab-operating mechanism

Emergency Systems
E1 Compressor bleed to pneumatic de-icing
E2 De-icing air filter
E3 De-icing suction
E4 De-icing pressure
E5 Discharge from venturi
E6 Solenoid distributor valve
E7 Connectors to boots
E8 Firewall Zone 1
E9 Firewall Zone 2
E10 12lb double-headed fire bottle each nacelle
E11 Fire-suppression to Zones 1 and 2
E12 Fire-suppression cross-feed
E13 Pressure-locked outward-opening emergency exit
E14 External handle
E15 Fire-access panels
E16 Ice-protection strip
E17 De-icing boot (span-wise)
E18 De-icing boot (chordwise)

Fuel system
F1 Integral tanks (1,150 gal total)
F2 Gravity filler
F3 Vent
F4 Contents unit
F5 Feed to collector tanks
F6 Collector tank (5 gal)
F7 Booster pumps
F8 Cross-feed cock
F9 Ground service cock
F10 L-p. cock
F11 Feed to engine
F12 Fuel heater
F13 L-p. filter
F14 38/62% water/methanol tanks, 30 gal each side
F15 Water/methanol feed
F16 Water/methanol pump access
F17 Fuel-heater air exit
F18 Fuel-filter access

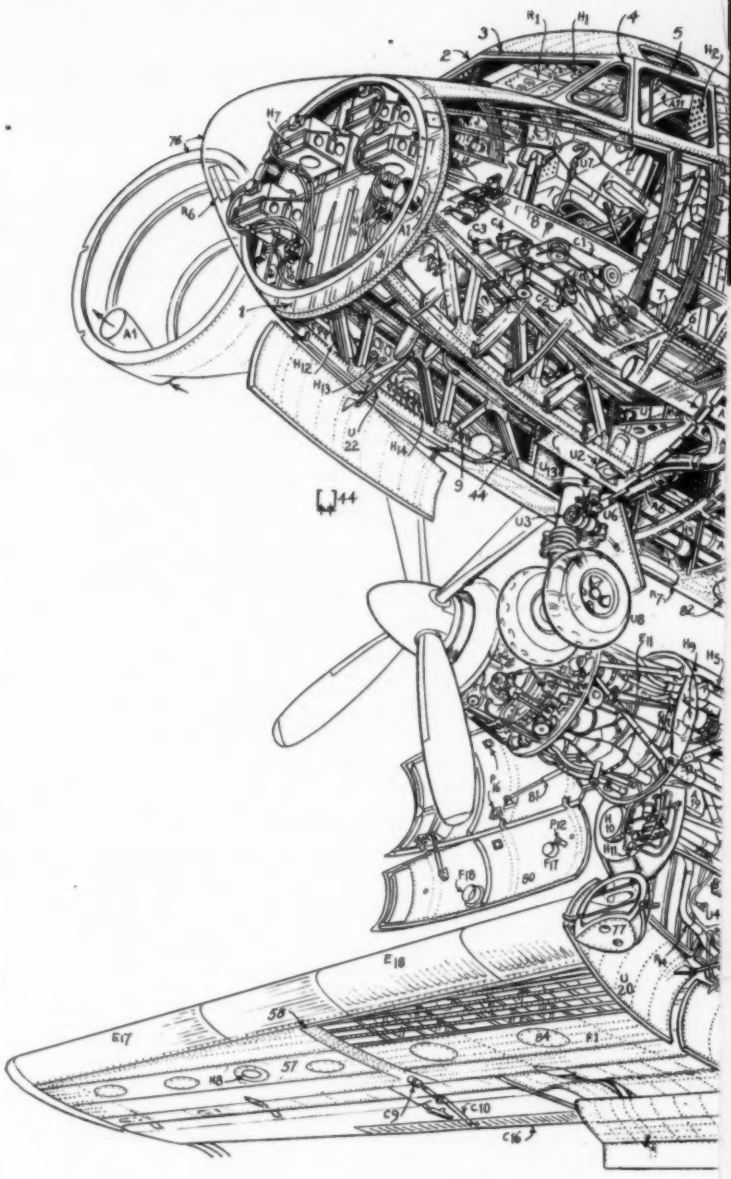
Hydraulic and Electric power
H1 Electrical control panel
H2 Circuit breakers
H3 Cable ducts
H4 Alternator 22kVA, 3-ph, 200V
H5 Generator 6kW, 28V d.c.
H6 Generator cooling air
H7 Batteries (4×24V, 23 A-h)
H8 Retractable landing lamps
H9 Hydraulic pump
H10 Header tank
H11 Test points
H12 Hydraulic accumulator
H13 Pressure gauges and charging point
H14 Hydraulic service bay
H15 Hydraulic pipe runs
H16 Electric relays
H17 Electrical panels
H18 Voltage control (port and st'b'd)
H19 Invertors 450VA, 115V

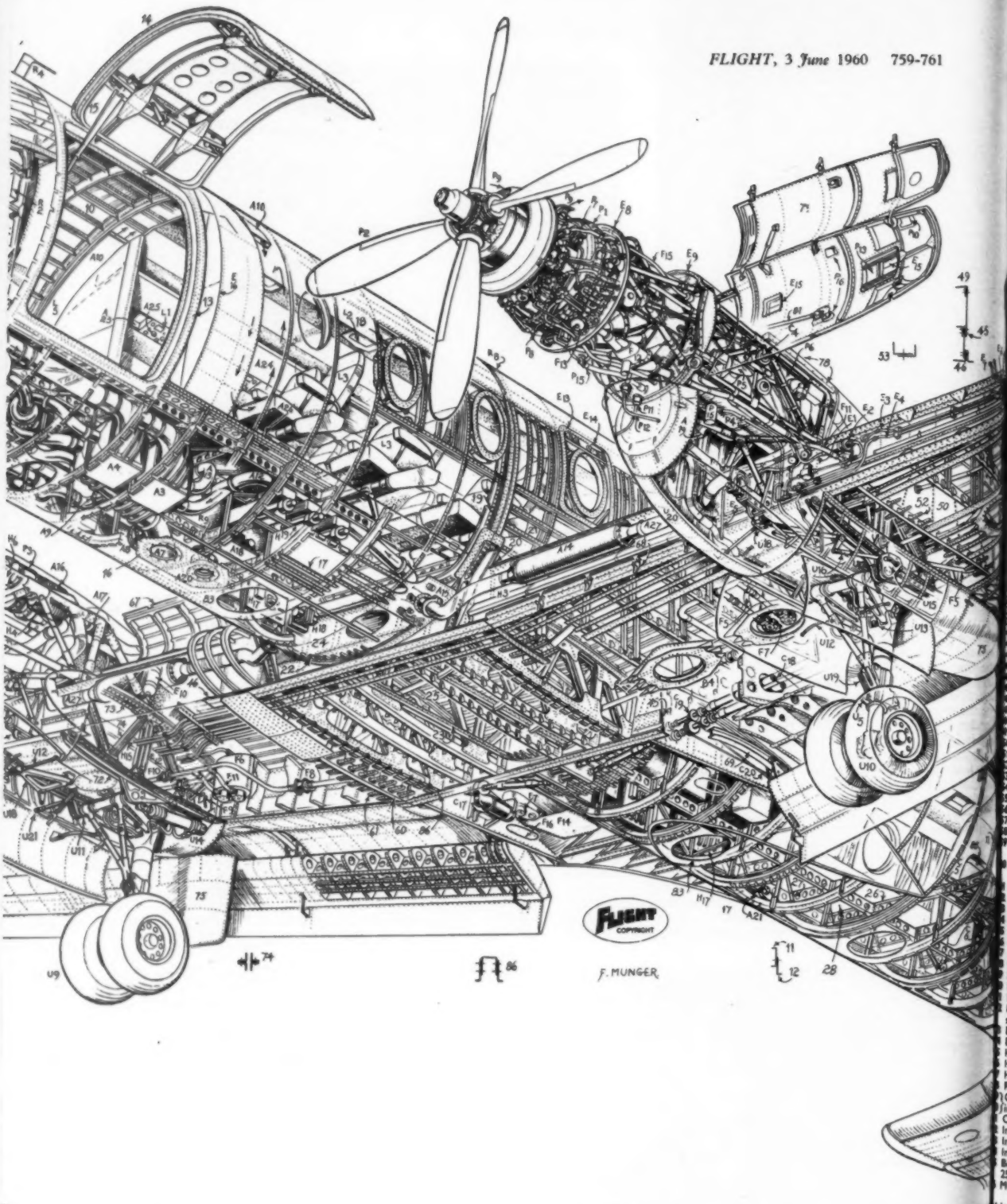
Load furnishing
L1 Passenger-service sliding panel
L2 Roof lights
L3 Lightweight lg seats, 36in pitch in 40-seat version
L4 Baggage or toilet 148 cu ft
L5 Baggage or galley 166 cu ft

Powerplant
P1 Rolls-Royce Dart (R Da.6) Mk 514, 1,600 s.h.p., s.f.c. 0.75
P2 Rotol 12ft propellers, auto pitch-coarsening
P3 Rotol 120 h.p. accessory gearbox
P4 Jetpipe shroud, British Refrasil blankets
P5 Jetpipe-shroud cooling air
P6 Stainless-steel accessory drip tray
P7 Oil-tank filler
P8 Filler drain
P9 Oil-cooler airflow
P10 Oil-filler and dipstick access
P11 Cowling drain
P12 Turbine drain
P13 Pressure-relief doors
P14 Engine breather
P15 Combustion-chamber drain
P16 Bay venting air

Radio
R1 Radio control pane
R2 Radio racks
R3 Static discharge wicks
R4 VHF aerial
R5 ILS VOR aerial
R6 Glide slope aerial
R7 Marker aerial
R8 ADF Loop aerial (top fuselage)
R9 ADF Sense aerial

Undercarriage
U1 Nose-leg pivot
U2 Nose-leg ram
U3 Steering cylinder
U4 Up-lock
U5 Up-lock pin
U6 Steering control valve
U7 Steering control
U8 Tyres 8.50×1
U9 Tyres 10.75×
U10 Maxaret bral
U11 Main-leg pivo
U12 Door operati
U13 Down-lock
U14 Main-leg ram
U15 Preclosing do plate (fixed)
U16 Cam follower
U17 Operating lev with leg pivo
U18 Door operati
U19 Pick-up for d
U20 Preclosing for
U21 Linkage disco
U22 Leg-operated





AVRO 748

The following data are accurate or the Avro 748 Series 1 at the time of going to press. Where different, data for the Series 2 are given in parentheses. Estimated performance figures are for ISA conditions, zero wind, at max weight.

Powerplant Two Rolls-Royce Dart RDa.6 Mk 514, each rated at 1,600 s.h.p. or 1,742 e.h.p. (two Rolls-Royce Dart RDa.7 Mk 531, each rated at 1,910 s.h.p. or 2,105 e.h.p.).

Dimensions Span, 95ft; length, 67ft; height, 24ft 10in; track between main legs, 24ft 9in; wheelbase, 20ft 1in; external diameter of fuselage, 8ft 9in; wing area (gross), 795 sq ft; passenger cabin length, 46ft 6in; constant headroom, 6ft 4in; width (max) over interior trim, 8ft 0.75in; gross volume (excluding flight deck), 1,990 cu ft; internal fuel capacity, 1,150 Imp gal.

Weights (lb, 40-passenger layout) Basic operational, 18,794 (19,690); operator's service items, 177; crew, 473; fuel, 3,570 (5,670); water/methanol, 320; payload (passengers 6,600, baggage 1,800, freight 1,266), 9,666; maximum gross, 33,000 (36,000).

Estimated performance Take-off distance to 35ft at sea level, 2,520ft (2,560); take-off balanced field length at sea level, 3,500ft (3,510); initial rate of climb at max recommended power, 1,350ft/min (1,630); service ceiling (100ft/min) at recommended r.p.m., 30,500ft (29,000); cruising speed at max recommended power, 230 kt (260); stage-length with full 9,666lb payload and hold for 45min at 5,000ft, 442 n.m. (830); payload for 1,000 n.m. stage with 45min hold at 5,000ft, 6,816lb (8,750); landing distance from 50ft at max gross weight at sea level, 2,190ft (2,325); landing field length at sea level, 3,650ft (3,880); stalling speeds at max gross weight at sea level, e.a.s., flaps up 93.3kt (97.2), flaps in take-off position 75.6 (79); full flap 70.6 (73.8); unstick e.a.s. 90.5 (94.5); approach, 91.9 95.9); touchdown e.a.s., 81.3 (85).

of feeding its own engine. For servicing, the pumps can be removed without interfering with any other part of the fuel system. There is the usual cross-feed arrangement so that both engines can be supplied from one tank if necessary. Pressure refuelling is standard, but gravity fuelling is possible through a filler cap on the top of each wing.

To ensure that the sealing of the tanks will stand up to all the rigours of flight loads and atmospheric variations, a representative portion of the wing structure incorporating a tank is currently undergoing a programme of combined bending and torsional loading in Avro's altitude chamber at temperatures varying from −50 to 80°C. The test programme covers a complicated repetition of gusts and ground loadings at normal, high and low temperatures, with the tanks empty and filled with fuel. Each series of 11,000 cycles requires a total of some 9,240 applications of 10ft/sec gusts, 99 applications of 25ft/sec gusts, one 40ft/sec gust, and 1,650 applications of 1.5g loading. The complete programme is equivalent to about 4,000 flying hours. To date the specimen has completed a total of eight such programmes, equivalent to 88,000 cycles or 32,000 flying hours, with no sign of leakage.

The cabin pressure system provides for a maximum differential pressure of 4.2lb/sq in, giving a cabin altitude of 8,000ft at an aircraft altitude of 20,000ft. On the Series 2 aircraft, which may fly at greater heights, maximum differential is increased to 5.5lb per sq in, giving a cabin altitude of 8,000ft at 25,000ft. Each of the engine-driven Godfrey blowers, which work in parallel, is capable of supplying 1lb/min of fresh air per person. A full fresh-air system with no recirculation has been chosen. Ram-air heat exchangers cool the compressed air before it is ducted into the cabin. Temperature is controlled manually, but automatic control is optional. Provision is made for a cold-air unit if additional cooling is required.

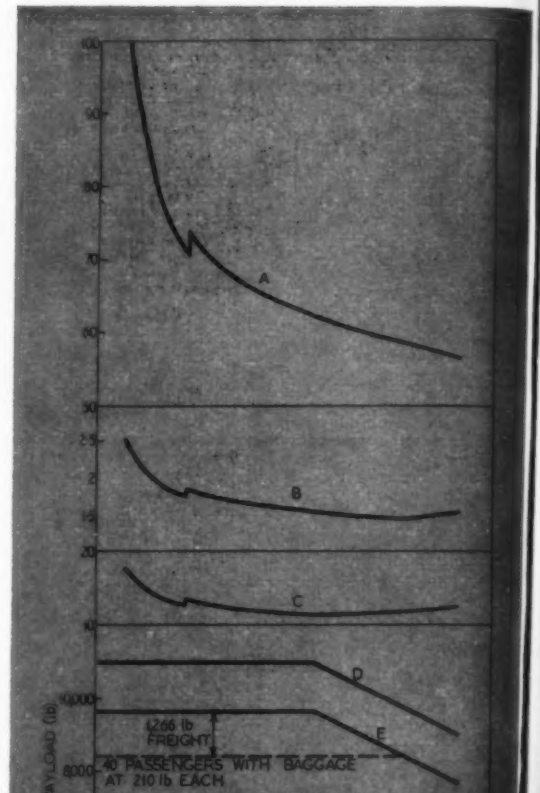
The main electrical system is 28V d.c., supplied by two 6kW engine-driven generators. If both should fail two Ni-Cd 24V, 23 A-h batteries supply essential services—flying and engine instruments, VHF, cockpit lighting and emergency cabin lighting, and one of the two 115V, 400c/s inverters supplying radio and instruments. On each side of the aircraft the cyclic electrical de-icing systems for engine intake, propeller, and Triplex gold-film windscreen panel are supplied by 22kVA, 200V three-phase variable frequency alternators. Should one alternator fail, the other will supply both engines and propellers, and the first pilot's windscreen panel.

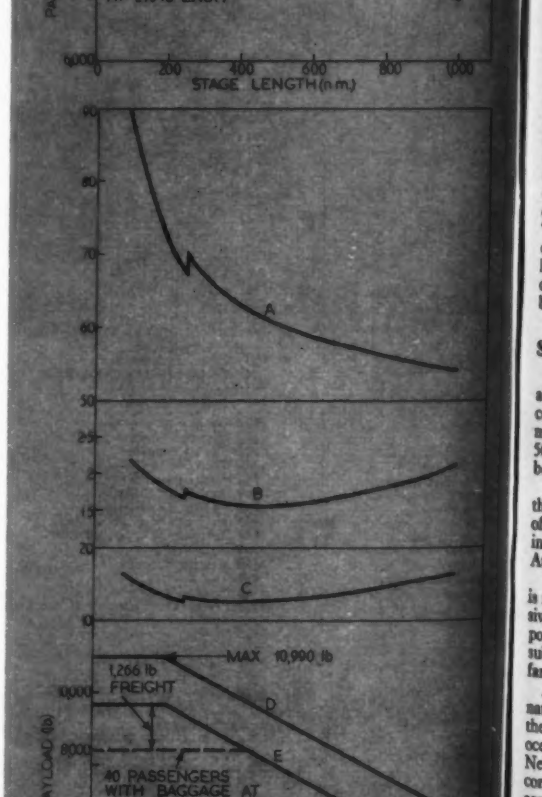
Airframe de-icing is by BTR Goodrich inflatable boots, with chordwise passages supplied from the engine compressors. This system was approved by the ARB after being extensively flight tested by Avro by D. Napier & Son, on their icing test-bed Lincoln, which was fitted with a complete representative wing section. Radio equipment will be to customer requirements; provision is made for installing all current equipment, including VOR, ILS, Decca Navigator and weather radar.

One field in which the Avro 748 may well have set a record is speed of design and construction, for it was as recently as January 1959 that Avro's drawing office started work on the project. Because of the orthodoxy of the systems and the use of well-tried components, Avro are hoping to find that their test-flying programme will be confined mainly to proving handling and performance. Only the first two aircraft have been allocated to the certification programme, and clearance to both FAA and ARB standards is scheduled for spring 1961. The second prototype will also be used for demonstration, and it is being fitted up with a mixed bag of lightweight seats—by Aircraft Furnishings; Flight Equipment and Engineering; Flying Services, Engineering and Equipment; Microcell; Rumbold; and Teco.

Two more aircraft have been allocated to structural testing. One complete airframe will be tested statically to destruction at Woodford, and another is currently undergoing a water-tank fatigue test at Chadderton. These tests are the culmination of an intensive programme of structural component tests, including measurement of the rate of growth of artificially induced cracks under repeated loading.

An initial batch of 10 aircraft and components for another 20 are at present being built, while production jigs are being made with a view to further production at the rate of three to four aircraft per month. Apart from the orders already noted at the beginning of this article, there is considerable interest in the 748 overseas, and Avro are optimistic for its prospects both in the less-developed areas of the world, for which it has been primarily designed, and as an economical general-purpose civil and military transport for all countries.





On the right are estimated basic operational curves for the Avro 748 Series 1 (right) and Series 2 (above). In each case curve A is direct operating cost (all DOCs are based on the 1959 SBAC method) in pence per aircraft nautical mile; B is DOC in pence per seat n.m. and C is pence per short ton (2,000lb) n.m. At the bottom of each set of curves is a plot of payload/range; D refers to the all-freight configuration and E to a typical 40-seat passenger version

Masefield on Air Transport's Future

POINTS FROM A ROYAL SOCIETY OF ARTS LECTURE

THE author, Peter Masefield, was until recently managing director of Bristol Aircraft, and is a former chief executive of BEA. He was at one time UK civil air attaché in Washington. The lecture, given on May 25, was entitled "The Problems and Prospects of Air Transport."

THE air transport business has now been built up to a substantial size. During 1959—air transport's fortieth year—there were some 96 million individual passenger journeys on airlines of the western world, and some 60,000m passenger miles were flown—an average journey distance of a little more than 600 miles for each passenger. Passenger traffic accounted for some 78 per cent of the total revenue load ton miles operated, cargo and baggage for some 17 per cent, and mail for the remaining five per cent. Thus air transport is distinct from almost all other forms of transport in that passenger traffic and passenger revenue predominates. At sea 86 per cent of the revenue comes from cargo. Freight traffic on the railways accounts for 74 per cent of its income. Even on the roads goods loads account for 48 per cent of the revenue earned by public transport services.

Although passenger traffic represents the major preoccupation of the world's airlines, even in these times of 100- to 180-passenger jet aircraft cruising at up to 600 miles an hour the average number of passengers carried in each aircraft is only 31 (at 58 per cent passenger load factor, in an average of 53 seats available in each aircraft), while the average cruising speed achieved on all the world's airlines in 1959 was 217 miles an hour.

On the cost side, world air transport is working out at some 56 pence for each load ton-mile operated—or just over fivepence a passenger mile. By comparison with other forms of transport, on a capacity ton-mile basis, estimated figures work out as follows: Air, 35.0 pence per c.t.m. at 217 m.p.h.; road, 4.0 pence per c.t.m. at 20 m.p.h.; rail, 1.5 pence per c.t.m. at 20 m.p.h.; sea, 0.15 pence per c.t.m. at 15 m.p.h.

There seems no doubt, now, that the supersonic transport aeroplane—cruising somewhere between 1,500 m.p.h. and 2,000 m.p.h.—will be a reality before the 1960s are over, and that it will be a major factor from the decade of the 1970s onwards. There seems, equally, little doubt that—for long-range operations—the supersonic transport will be an economic proposition at fares comparable to those which prevail today. For short and medium ranges it is much less attractive on grounds of cost and noise.

Short-range inter-city services are, however, best suited to the development of the large helicopter. A major advantage of this form of vehicle is its ability to cut out the slow and frustrating journey from city-centre to airport by flying directly from city-centre to city-centre. The large helicopter of the next decade seems likely to turn out to be reasonably economic only for distances of between 100 and 250 miles. But before it can be used satisfactorily the noise problem has to be overcome. In this direction the type of transmission which depends upon a form of jet propulsion from the tips of the rotor blades—such as is used on the Rotodyne—is much less easy to make tolerable than the "twiddle-in-the-middle" form of transmission from turbine engines driving rotors through shafts. Now that all British helicopter development is centred under one company's control, concentration on the most tolerable solution may, in due course, be easier to achieve.

Scope for Medium Hauls

A study made recently in the US showed that 57 per cent of all passengers travelled for journeys of less than 50 miles; 18 per cent between 50 and 100 miles; 15 per cent between 100 and 250 miles (this is the helicopter field); 6 per cent between 250 and 500 miles; 2.5 per cent between 500 and 1,000 miles; 1 per cent between 1,000 and 1,500 miles; 0.5 per cent more than 1,500 miles.

In the area of journeys of between 250 miles and 1,500 miles—the medium-haul fixed-wing field—54m passengers (10 per cent of the total travellers by all forms of transport) moved in the U.S.A. in 1959. That is some 15 times the total traffic which crossed the Atlantic by sea and air in the same year.

These medium-haul sector distances over which the helicopter is not suitable, and the supersonic transport potentially very expensive, represent some of the most lucrative future fields for air transport and the best field for the future exploitation of the economic subsonic jet—probably, in the next decade, powered with ducted-fan low-consumption engines.

A feature of air transport is the fact that even the smaller nations consider that their national prestige must be served by the operation of an international airline, often across the major oceans of the world into the bigger traffic centres such as London, New York, Paris and Rome. A natural—and uneconomic—corollary of this is the tendency to negotiate restrictive traffic agreements so that traffic is more or less forced to fly in equal proportions by the national carrier and its foreign reciprocal, regardless of the respective efficiencies, records and attractions of the different airlines.

These restrictive practices—usually by limitation of frequencies and by the denial of the so-called fifth freedom rights to airlines of third countries, seems to be on the increase rather than the reverse. Such a policy results in the pernicious doctrine of the "roped-off seat." The problem is certain to get more acute when the era of the supersonic transport arrives. Small nations will not be able to afford aircraft costing, perhaps, £4 million each. If recent history is a guide, they may attempt to ban competitive supersonic services, except at very high premium fares, or they may insist that such services are restricted to a small proportion of the traffic demands. In either case the best interests of the travelling public are not being served.

If international air transport politics present a problem, some of the domestic issues are no less acute. In the United Kingdom, for example, the issue of how to provide a satisfactory arrangement under which the State corporations and the independent ones can live happily together remains unresolved. On this subject successive governments have known the precise psychological moment when to say nothing—and have continued to say it. The fact is that the State Corporations—BEA and BOAC—were set up to perform a particular job of carrying air traffic over designated routes at a profit and any undermining of their opportunities is liable to be looked upon as a betrayal of a trust.

Hope for Better Things

Quite obviously, the device of making independent companies "associates" of the corporations has not worked and could do no more than patch up an unsatisfactory situation. The projected Air Transport Licensing Board, with the means of making a full and impartial assessment of the economic and the public interest aspects of route allocations and competitive aspects, may well turn out to be a means of working out a practical solution which has so far eluded British air transport politics. We may hope for better things.

Air transport is not, however, showing the profitable results for which its advocates have hoped for so long. Some airlines will face a battle for survival. More mergers in airlines, as well as manufacturers, seem certain.

The chief reason for recent poor economic results is that the rate of re-equipment for the jet age has been outstripping the financial resources available. Air transport as a whole would be in a much more healthy situation, economically, had the jet age been postponed for five years or so.

The lesson may be learned for the decade ahead. Existing jet aircraft will be written down to relatively low book values before 1970 when the next major step in re-equipment can be expected. On medium range services, developments of present aircraft will probably provide the most satisfactory answer. Thus an improving situation can be looked for in the years ahead.

Such revolutionary new vehicles as the Hovercraft or VTOL jet will not, in my view, be likely to play any significant part in commercial air transport during the 1960s. The Hovercraft is, in reality, a displacement vehicle—like a ship or a motor car—rather than a lifting aircraft. It uses the air as a cushion to reduce friction, but in all other respects can be considered a means of surface transport. And, in the development stage at least, it will remain slower than modern aircraft and more expensive to operate than other surface craft.

The VTOL jet will not be likely to come into service for commercial air transport during the next decade because of its high operating cost and high noise level.

One thing should never be forgotten about commercial air transport—and, indeed, about commercial transport of any kind. That is that the purpose of transport is to serve the community in the widest sense—that public interest transcends private interest, that public accountability has to be married to individual enterprise and that "full information" is the best guarantee of sound intentions. Commercial aviation—above all other means of transport—has immense prospects for the future. Its wise public regulation and its imaginative private development must be related in full proportion to gain the results which all the world hopes from it.

Two examples of the Piaggio P.166 are illustrated in these photographs. Left, the attractive P.166 executive operated by McAlpine Aviation and based at Luton Airport; right, the interior of the P.166 utility owned by the Italian oil company AGIP, in which the normal reclining seats can be replaced by the simpler seating shown for transporting the company's working personnel between bases. The total number of passengers carried in this arrangement is nine (plus the second pilot's place)

Sport and Business

THE FIRST RACE EVENT on the Royal Aero Club's competition calendar this year takes place this weekend, June 3-4. Today (June 3) the London - Cardiff race will be held, starting from White Waltham Aerodrome at 5 p.m. The course is a dogleg track between White Waltham and Rhoose Airport, Cardiff, with a turning point 10 miles south-west of Lulsgate Aerodrome, and aircraft are expected to cross the finishing line at Rhoose from about 6 p.m. on. A total of 47 aircraft have been entered for the race, and tomorrow (June 4) these will be divided into three classes and will race around three and four laps of an 11-mile circuit for the Air League Challenge Cup, the Norton-Griffiths Challenge Trophy and the de Havilland Tiger Moth Challenge Trophy. The placings in these three class races will decide the entry list for the King's Cup race, which is to be held at Baginton on July 9. Saturday's racing will form part of a full display programme which includes aerobatics by the Hunters of "Treble One" Squadron. The host club for the occasion, designated the 1960 International Welsh Air Rally, is the Glamorgan Flying Club.

There are few surprises in the entry list for the Cardiff races, apart from a Fairey Fulmar to be flown by J. S. Fairey and the first appearance of the Hampshire Aeroplane Club's Currie Wot G-APWT, to be flown by J. F. Underwood. Also from Eastleigh, the Hampshire Club's two-seat Spitfire 8 G-AIDN will be flown by V. H. Bellamy. The only representatives of the current generation of American private and executive types are three Cessnas —Models 210, 310 and 175—while for the vintage generation this event marks the reappearance of Comper Swift G-ABUS, flown by C. Boddington. For the second year in succession the Duke of Edinburgh has entered Turbulent G-APNZ with his equerry, Sqn Ldr John Severne, as pilot.

LASHAM GLIDING SOCIETY invited the public to visit them "At Home" on Saturday, May 21, as they had done on two previous occasions. Among the pilots present were Edwin Harrold of Rhodesia, who will be flying a German Ka 6 in the World Gliding Championships at Butzweiler, and Anthony Deane-Drummond of the British team, with his finely finished cream-and-orange Skylark 3F. In spite of poor visibility and low cloud a fine display was given of aerobatics and aerotowing. After each demonstration the pilot had to land in a "field" marked out in coloured balloons: the first one to successfully stay within the bounds was Brian Masters in an Olympia 419. Derek Piggott in a Polish Bocian two-seater and Les Creed in a Skylark 2 gave polished aerobatic displays.

SEVENTEEN NETHERLANDS LIGHT AIRCRAFT are due to participate in the Whitsun Leinster Aero Club Rally. Six aircraft from Weston, County Kildare, were going to Rotterdam during the weekend preceding Whitsun, ranging in age from the veteran Avro Club Cadet (Armstrong-Siddeley Genet Major) G-ADIE, to a Piper TriPacer, returning to Ireland on the morning of Saturday, June 4, via Calais, Lympne, Rhoose, and Dunmore East. The aircraft taking part in the rally are due to arrive at Weston between 4.30 and 6.30 p.m.

A FIVE-MAN TEAM of parachutists claimed a new British record for a delayed drop made on May 14 from an Otter aircraft over Essex. Jumping from a height of 19,500ft, they opened their parachutes 92sec later at 2,000ft. The team comprised David Hall, Peter Lang, Mike Reilly, Tony Millar and Malcolm Morris.

The Lockheed JetStar prototype (right) has been modified to incorporate most of the features of the production model. Powered by four Pratt and Whitney JT12s, the aircraft has Rohr thrust reversers, high-lift wing leading-edge, and dual-wheel landing gear. The current flight-test programme is aimed at Federal Aviation Agency certification

At Oxford Airport, Kidlington, the Pressed Steel Co Ltd not only operate their own executive fleet, but also the airport itself. Here on the tarmac at Kidlington are seen the company's first aircraft, a D.H. Dove, together with the second, a Piper TriPacer. In the background is the headquarters of the Pressed Steel Aviation Division

THE PIAGGIO P.166 recently acquired by John Laing & Son Ltd, building and civil engineering contractors, made its first business flight on May 23 when it carried executives of the company from the aircraft's Luton base to construction sites in the Bristol and Swansea areas. The Laing Piaggio, which was purchased from McAlpine Aviation at Luton at approximately £49,000, is equipped with airline standard radio equipment comprising two VHF sets, VOR, ILS and ADF units.

THE BREAKFAST PATROL organized by the London School of Flying at Elstree on May 22 was a successful meeting, in spite of uncooperative weather. Attacking aircraft numbered 16, six of which were successful in reaching Elstree unobserved. The defending patrol comprised five Chipmunks and one Auster belonging to the London School, together with a Gemini, Messenger, Tri-Pacer and two Austers from Middlesex Flying Group and a privately owned Messenger and Moth Minor.

Recently formed at Derby by the London School of Flying's parent company is Derby Airways Flying Group, whose members have rebuilt Magister G-ANWO and are operating it under the supervision of instructors from Derby Air Centre.

CERTIFICATES OF AIRWORTHINESS in the public transport category (hire and reward) have now been received for the Piper Apache and Super Cub 150, as well as the Tri-Pacer and Caribbean. Vigors Aviation, the UK Piper distributors, state that the issue of similar certificates for the Comanche and the Super Cub 95 is imminent, and that the necessary data for the Aztec are being prepared.

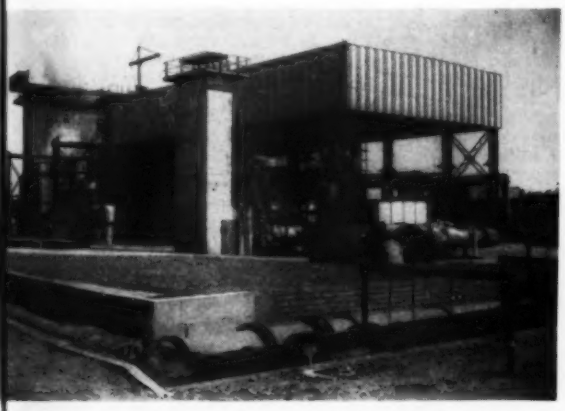
RETROSPECT

From "Flight" of June 4, 1910

Mamet at Valencia: As a finish to a series of exhibition flights which he has been giving at Valencia, Mamet arranged to fly over a ballonet at a height of 500 metres on Monday last. After a flight of 15min he attained the height of the ballonet, but just then his motor stopped for some reason, and he fell into the sea, from which he was rescued by a motor boat. Nothing daunted, the aviator determined to make another attempt on his second machine, but this time the cord holding the ballonet broke. To compensate, the aviator gave the crowd a series of thrills by flying in a figure eight, and by planing flights.

A HIGHLY SUCCESSFUL COURSE for beginners was organized by the British Parachute Club at Fair Oaks last month. During the five-day period a total of 106 jumps was made by the 12 pupils under training. Instruction was given by John Hogg, using an Auster of Fair Oaks Aero Club. Treble jumps were made from the Auster within a 3sec period, and the greatest number of drops by a pupil during the course was 11, five of which were made in one day. The club hopes to run another fulltime course for newcomers to the sport during October next.

AUTOMATIC REJECTION of applicants over 55 years of age for Student Pilots Licences and Private Pilots Licences in Australia has been replaced by a medical examination, which will have to be repeated at two-year intervals.



An external view of part of cells 2 and 3 at the new NGTE engine test facility. A supersonic ramjet is running in one cell

NGTE ON SHOW

IN the time that has elapsed since we last visited the National Gas Turbine Establishment at Pyestock, Hants, the Establishment has grown substantially; but one can also detect changes of a more fundamental kind. Five years ago propulsion engineers still tended to regard the engine as a separate entity; today the integration of propulsion and lift is fast becoming a reality, and in retrospect one can only wonder why aeroplanes have been so wrongly designed for so long.

Elaborating on this theme it seems that the way is at last open to the development of truly "optimized" aeroplanes. The jet transports which are today the pride of the world's airlines employ methods of lift and control which have not changed in principle since the dawn of powered flight; and even their propulsion is effected by basically military engines slightly modified to improve their suitability for commercial operation. Future airline engines will be both quieter and more efficient, and they will make available supplies of compressed air which will be instrumental in effecting a revolutionary improvement in lift and control. Such fundamental advances cannot be hurried, and it is the view of the NGTE that their introduction must come in phase with parallel improvements in completely automatic flight-control and air traffic control.

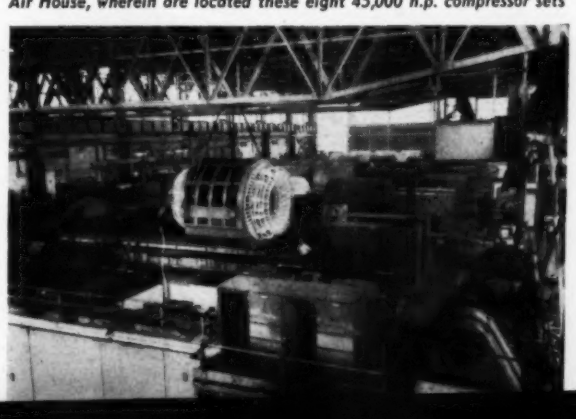
At the time of our previous visit the NGTE were in early stages of exploring the Jet Flap (*Flight*, September 30, 1955). As then conceived the concept was that of a thin spanwise slit beneath the trailing edge of the aerofoil, through which the aircraft powerplant would discharge a sheet of hot gas to provide lift and propulsion. This would fundamentally affect the circulation round the wing and greatly increase the available lift. The process is now being extended to provide direct control of circulation, while employing only very small injected flows.

Tunnel testing started with a hollow cylinder, in which were cut a pair of essentially tangential axial 0.005in slots spaced 90° apart. Even with a minute flow through these slits the theoretical maximum lift coefficient of 4π has been exceeded by a small margin. To translate the idea to a wing-like lifting surface investigations are in hand on aerofoils having a section of a 20 per cent ellipse. Tests have been completed on a low-lift configuration and a high-lift design is now in the tunnel. A third shape, in which three tangential slits will all attempt to push the rear stagnation point around the trailing edge and as far as possible forwards along the undersurface, is expected to give lift coefficients approaching the theoretical maximum of 2.4π.

Practical application of such systems has been rendered possible by the advent of such engines as the Bristol Siddeley BS.75 and Rolls-Royce RB.163. Both could supply the flow required through lightweight ducting, delivery conditions being about 60°C and 1.9atm pressure to choke the blowing nozzles—holes, not slits, are suitable—at take-off. It is now known that the complete propulsion system can be so designed that sudden engine failure will cause no undue adverse effect on the remaining engines or on the lift or control of the aircraft. One set of curves, drawn for a hypothetical NGTE engine installed in a four-engined aircraft at 60kt at sea level, shows that with a total bleed of 30 per cent failure of one engine will not decrease lift by more than 5 per cent. This could be immediately counteracted by the pilot pulling up the nose of the aircraft very slightly.

Most of the expansion at Pyestock is accounted for by the Engine Test Facility, now nearing completion. Representing an outlay of many millions, it will be the first plant in Britain capable of running advanced air-breathing engines under genuine flight conditions, including investigations into intakes. We saw, for example, a free-jet test on a 16in ramjet (not a Thor) running at M2.2 at 50,000ft, with an airflow of 480ft/sec and pressure ratio of 9 : 1. Change of incidence at the conventional centrebody-type intake caused rich-extinction at a nose-down incidence of about 10°. Other subjects covered included the design of supersonic intakes, jet-engine noise, lifting fans and the application of nuclear power to gas turbines (in which sphere the NGTE have little interest in aircraft applications).

Most of the motive power in the new facility is provided from the Air House, wherein are located these eight 45,000 h.p. compressor sets



Farewell to the Bristol Beaufighter, after 20 years' RAF service: RD761, of the station and target-towing flight at RAF Seletar, Singapore, being flown on the last Beaufighter operational sortie — round Singapore Island, on May 16 —by Fg Off H. Marshall, who was subsequently presented with the control column handgrip as a souvenir. Beaufighters entered service in 1940, with Fighter Command, equipped with AI radar. They subsequently operated successfully with Coastal Command, and in the ME and Burma

SERVICE AVIATION

Air Force, Naval and Army Flying News

To and From Aden

CHANGES have been made in three higher RAF appointments following the decision of Air Chief Marshal Sir Hubert Patch to relinquish his position as Commander - in - chief, British Forces Arabian Peninsula, owing to ill-health. He is being succeeded there by Air Marshal S. C. Elworthy, who in November last year became Deputy Chief of the Air Staff. That post is being taken over (from July 18) by AVM R. B. Lees, who will have the acting rank of air marshal; and he is being succeeded as SASO at Fighter Command headquarters (from June 1) by Air Cdre E. L. Colbeck-Welch, who will have the acting rank of air vice-marshal.

Air Chief Marshal Patch took over the Arabian Peninsula command on October 1 last year and was the first C-in-C to have overall command there over three individual Service commanders of major-general or equivalent rank. No other appointment has as yet been announced for him. Air Marshal Elworthy was commandant of the RAF Staff College at Bracknell before he became DCAS, and AVM Lees has been SASO at Fighter Command since October 1958. His successor there, Air Cdre Colbeck-Welch, became SASO at No 13 Group in November 1958.

US Navy at West Malling

AFTER being reopened as an operational station in August last year, RAF West Malling is to come under US Navy administrative and operational control from October and its Javelin Squadron (No 85) will move elsewhere. The USN unit moving to the station (where the RAF will keep a liaison unit) is the transport and communications squadron at present based at Blackbushe, which was being closed at the end of last month.

When No 85 Sqn went to West Malling last year it resumed long-standing associations with the station, which had been closed since December 1957.

Best Man for the Job

VALUES of a University education were stressed by Air Marshal Sir Herbert Spreckley, Controller of Engineering and Equipment at Air Ministry, when he spoke at the Durham UAS dinner on May 20. It enabled men from different faculties to mix and to indulge in a variety of extra-mural activities, thus giving them a broader and more mature outlook. The RAF attempted to give a similar kind of training at its colleges, such as Henlow, but also sent a proportion of technical cadets to the universities.

Sir Herbert stressed that the RAF needed a proportion of university-trained men; and on the question of the Service prospects of a university graduate compared with those of a Cranwell man, and GD *vis-à-vis* the technical branch, he said that the Air Council were considering how to make it clear that it was a case of "the best man for the job"—regardless of branch or background. They were contemplating a common Air Rank List, instead of separate lists for air officers according to branches. As proof of this policy, Air Marshal Spreckley enumerated the many officers in ground branches now holding air rank. He commended Durham University's good reputation for engineering and said that Henlow was sending a cadet there this autumn.

Successful Double Ejection

BEHIND the cold communiques about Exercise Yeoman there was at least one story which caught the headlines: the escape of two crews of No 29 Sqn after their Javelins had collided at 40,000ft over the North Sea, some 40 miles off the Durham coast. The rescue of one of these crews from the sea was due partly to the pilot of a sister Javelin squadron (No 33) who followed their aircraft down, and partly to the assistance of a Shackleton of No 42 Sqn which was on standing patrol and dropped two sets of Lindholme gear.

The collision occurred at 1415hr on May 21 at a point 65 n.m. north-east of RAF Middleton St George. The aircraft involved were XA835, with Flt Lt D. J. Wyborn as pilot and D. S. J. Clark as navigator, and XA823, flown by Flt Lt J. S. Wilson with Fg Off E. Wood as navigator. The nose of Wyborn's aircraft was torn off, but he managed to retain some control and brought the Javelin down to 14,000ft before he and Clark had to eject. He attempted before leaving to direct the aircraft over the sea, but as he and Clark were descending by parachute it turned and went over the land, fortunately coming down in open country.

Wilson and Wood had to eject immediately, because the tail of their aircraft was destroyed, and their descent was watched by Flt Lt D. Freeston of 33 Sqn. The Shackleton, flown by Flt Lt B. C. Letchford, was ordered to the scene at 1425, when it was between 30 and 40 miles distant. Picking up signals from the Sarah beacons in the dingies it located Wilson and Wood at 1511 and Whirlwinds were homed to them. The two men were

(*continued at foot of following page*)

The Duke of Gloucester presenting the Duncan Trophy, for air firing by RAF fighter squadrons in Germany, to No. 26 Sqn (Sqn Ldr D. L. Edmonds) at Gutersloh; and at right, the Gruenther Trophy, top award in the Royal Flush V reconnaissance competition, being presented to Maj J. E. Fritsch of 4th ATAF by Gen P. Stehlin, French Air Force Chief of Staff

"Flight" photographs

Vintage generation: ten members of the "platform" who served in the RFC or RNAS: included are Air Chief Marshal Sir Hugh Lloyd, C. A. Allen, Wg Cdr W. H. N. Shakespeare, Air Chief Marshall Sir Robert Saundby, K. T. Jago, Air Chief Marshal Sir John Baker, Air Marshal Sir Thomas Warne-Browne, Air Chief Marshal Sir Ronald Ivelaw-Chapman, Air Marshal Sir Harold Lydford and T. N. Barling. AVM Sir Geoffrey Bromet was visiting his area representatives when the group was photographed

THE RAFA CONFERENCE

FOR the first time, Harrogate was the venue for the annual conference of the Royal Air Forces Association. Whether or not the famous waters or the warm sunshine and superb floral displays combined in their benign impact on delegates, the 1960 conference last weekend will be remembered as the mildest and most pleasant of a long series. Absent were the almost acrimonious exchanges between the platform and the floor which have marked previous gatherings. But the RAFA never wearies of well-doing. After a broad decision has been taken, delegates will argue and argue as to "how"; they will split hairs, become vehement and invoke the letter of the constitution in aid of their personal ideas of charity.

A number of familiar faces were missing from the platform. Regret was expressed at the absence of Lord Tedder, who is in hospital—he sent a message apologizing for having had a "forced landing"; of Dame Helen Gwynne-Vaughan, who for the first time over so many years felt the journey too great to be faced. The deaths of Sir Frederick Bowhill and G/C Vaughan during the year had also removed two well-known figures from the national council. Lord Tedder's place as chairman of the conference was taken by Air Marshal Sir Robert H. M. S. Saundby.

As is usual, the first session was devoted to pensions and welfare. For once it was impossible for the delegates to get steamed up over these subjects, for it was pointed out that the RAFA, in conjunction with the British Legion and other ex-Service organizations, had been able to get 17 major improvements granted. It was, however, pointed out that the minimum figure of £4 10s as a claimed basic pension was already out of date. Also, it was not to be wondered at that the political slogan "You've never had it so good" was parodied into "They've never had it so bad" when referring to old pensioners trying to live on a tiny fixed amount.

The 1959 conference had instructed the national council to investigate the problems surrounding the provision of a home or homes for the elderly. To this end, K. T. Jago submitted a special report on the care of the aged, together with plans of suitable buildings and detailed costs of such a scheme. The "floor," always unpredictable, now changed its mind and carried a resolution declaring such provision unnecessary in view of the increase in similar accommodation provided by local authorities. Delegates, having failed to recognize old age as an incurable disease, went on to instruct the national council to look into the possibilities of providing accommodation and services for those members suffering from chronic and/or incurable diseases.

A resolution deplored (again that much misused and overworked conference word) that no official permission is given by the Air Ministry for Wings Day collections to be made on RAF stations; the RAFA considers that an RAF charity should have special consideration.

Another 1959 resolution, by Stanley Branch, called for a more specific official dedication than that given by the lines of Laurence Binyon's "They shall grow not old . . ." The conference approved the following, which was written by Sir Robert Saundby: *"In friendship and in service one to another, we are pledged to keep alive the memory of those of all nations who died in the Royal Air Force and in the Air Forces of the Commonwealth. In their name we give ourselves to this noble cause. Proudly and thankfully, we will remember them."*

An added resolution from the Newark Branch called attention to the recent Brighton Air Week, which sustained a loss of some £3,000. It "deprecated the obvious inefficiency of the organization." After Air Chief Marshal Sir John Baker—announcing himself as "Baker, Chislehurst and Sidcup Branch"—had said that he thought the money well spent and had pointed out the impossibility of forecasting whether a profit would be made, all joined in to acclaim the efficiency of the general secretary, G. R. Boak, and his department.

J. Y.

Standards are dipped during the remembrance service at Harrogate war memorial

Shell Mex Trophy (for area membership competition). — Northern Ireland Area. Runners-up, South Western Area.

Wings Day Trophy (highest net collection per head).—Omagh Branch.

Wings Day Trophy (highest net collection). —Glasgow Branch.

Wings Day Trophy (second highest net collection).—Belfast Branch.

Trefusis Forbes Wings Day Trophy (new trophy for overseas branches).—Kenya Coast (Mombasa) Branch.

Battle of Britain Trophy (highest net collection per head of membership).—Jersey Branch for the seventh year in succession; Jersey also won the Judge Trophy for the highest net collection made during Battle of Britain Week, for the sixth time in seven years.

Overseas Battle of Britain Trophy (highest net collection per head of membership).—Hong Kong Branch (for the fifth year in succession).

(*Continued from page 768*)

winched up after being in the water for respectively 2hr 20min and 2hr 33min. The three Whirlwinds were all from No 228 Sqn, and two of them—flown by Flt Lt Sparkes and M/Plt Boucher—carried out the pick-up from the sea. Rescue operations were directed by the Northern Rescue Centre at Pitreavie, Scotland.

First Stop Singapore

A NON-STOP flight of over 8,000 miles —from RAF Marham to Singapore— was made by a Valiant of No 214 Sqn on May 25/26. Captained by Sqn Ldr J. H. Garstin, the aircraft completed the distance of 8,110 miles in 15hr 35min at an average speed of 523 m.p.h. There were two in-flight refuellings, from Valiants of the same squadron, positioned at Akrotiri (Cyprus) and Mauripur (Karachi, Pakistan). The first refuelling took place at night, the tanker aircraft using floodlights.

Hack Trophy Contest

EVERYTHING conspired to make the Hack Trophy competition, held at Little Rissington last Saturday, a pleasurable occasion: especially for Manchester UAS, who excelled themselves by winning this coveted annual air squadron award for the first time, scoring 354½ points out of a possible 540. Conditions were perfect, both for watching and flying, with a light breeze and broken cumulus at about 3,000ft; and there was an encouragingly high-powered attendance, headed by the AOC-in-C Flying Training Command, Air Marshal Sir Hugh Constantine. When he presented the trophy to the winning squadron's commanding officer, Sqn Ldr S. A. Harris (who had once been his personal pilot), Sir Hugh warmly congratulated Manchester on their first-ever success.

Both AOCs of the two Groups in the Command, Nos 23 and 25 (AVM C. Scragg and AVM J. F. Hobler respectively), were also present; and there was an appropriate geographical distribution between the competing squadrons—Manchester, London, Glasgow and Durham. In the morning London had quite resoundingly beaten Southampton (the holders), Cambridge, Oxford and Bristol to win the regional Cooper Trophy; and they were hot favourites for the big event. But though they started well in the spot landing test, they fell behind Manchester in the forced landings; and despite a splendid effort by Plt Off M. J. Gibson, who got top marks for aerobatics, they were still five points in arrears at the close with 349½. Glasgow came third in the competition with 264½pt and Durham got 235. Manchester's winning team was Cdt Plt H. Blake (1st yr); Cdt Plt M. Baker (2nd yr); and Cdt Plt I. T. Nicoll (3rd yr).

No. 26 Sqn Reunion

A dinner for all past and present officers of No 26 Sqn is being held on Friday, June 17, at the Eccleston Hotel, London SW1. Tickets (30s) from Flt Lt F. W. Daley, RAF Chivenor, Barnstaple, Devon.

AIR COMMERCE

Imported turboprops: Of the three types of turboprop engine today earning money for US airlines, two are British — the Napier Eland and the Rolls-Royce Dart, here seen together at Philadelphia. The Eland (D.H. propeller) powers Allegheny's Convair 540s

"Flight" photograph

COMET 4 ACCIDENT REPORT

A SUMMARY of the report of the Indian Government's investigation of the accident to a BOAC Comet 4 G-APDA on June 8, 1959, at Calcutta has been published by the Civil Aviation Department in New Delhi. It appears in the department's *Monthly News Letter* (*No. 12*). The accident is attributed to pilot error. As already reported, Comet 4 flight manual approach speed was increased by 5kt after the accident. This is the summary:—

"The report of the Director of Aeronautical Inspection, Civil Aviation Department, on the accident to British Overseas Airways Corporation Comet aircraft G-APDA at Calcutta (Dum Dum) Airport, on June 8, 1959, has been accepted by Government.

"The aircraft, which was operating the Tokyo - London passenger service No SB-931 of BOAC, was attempting to land at Calcutta Airport with the aid of the Instrument Landing System. The earlier stages of the approach to Runway 19L proceeded without incident. However, turbulence was encountered necessitating increased power to stabilize the fluctuating air speed at the recommended figure. The increased power, however, was applied too late with the result that sudden sinking of the aircraft and an impact with trees could not be avoided.

"Thereafter, partial loss of lateral control was experienced as considerable damage had been caused to the flaps. Missed approach procedure was then successfully carried out. The next approach was made on to Runway 01R. The aircraft was then being flown by visual reference. During this approach the aircraft again impacted the trees as due allowance was not made for the higher stalling speed of the damaged aircraft. Missed approach procedure was again initiated and the aircraft responded well. Further damage had, however, been sustained. A circuit was executed and the landing during the third attempt was successful, but the damaged aircraft failed to pull up within the available length of the wet runway because of the higher speed at which the approach had to be justifiably made.

"No injury was sustained by the 44 passengers and nine members of the crew on board. The aircraft was, however, substantially damaged.

"The accident is attributed to an error of judgment on the part of flying crew in not applying increased power when approaching to land under turbulent conditions. The subsequent power increase was applied too late to prevent the aircraft, which was being flown at a speed below the speed recommended for turbulent conditions, from sinking and striking trees."

TURNHOUSE FOR EDINBURGH?

SERIOUS consideration is being given to a proposal for Edinburgh corporation to take over Turnhouse Airport, now run by the Air Ministry. If this were done—and it is reported that within six months the Minister of Aviation will ask the corporation to run the airport—Turnhouse would become Scotland's first municipally-owned airport.

Losses on the Scottish airports last year were about £500,000. While Edinburgh's attitude to taking over the airport is not clear, the views of Michael Clark Hutchison, an Edinburgh MP, and Sir Patrick Dollan, chairman of the Scottish Advisory Council for Civil Aviation, seem to be opposed. Mr Hutchison, who 18 months ago approached the Ministry with a suggestion that Edinburgh corporation might take over the airport, said: "I think it would be operated better by the corporation. The ones I know of in England which are municipally-owned seemed to work quite well." Sir Patrick Dollan opposes the plan on the grounds that airports should be in the control of the State as part of the national defence and for emergency services.

Edinburgh handled nearly 157,000 passengers last year, 35 per cent more than in 1958. No trading account is published.

THE POKER GAME

IF our interpretation of recent events is correct, the world's two major civil air powers, the United States and Great Britain, are on cool terms with each other at the moment. Six solid weeks of negotiation to resolve differences over the so-called Bermuda Agreement have been adjourned. A brief Ministry statement said tersely: "It was not possible to reach agreement"—not even conceding, as diplomatic protocol prescribes in the event of disagreement, that there had been "a full and frank exchange of views."

There has certainly been no full and frank exchange of traffic rights. The six-week poker game (a knowledge of poker is a desirable attribute of your successful traffic-rights negotiator) has not actually ended with a grand slam of the Ministry's door, which apparently remains open. And it would perhaps be going too far to say that each side regards the other as a four-flusher. But all the cards have been put on the table, and each side is in no doubt of the other's hand.

Neither country has budged from the position in which it was entrenched when the first round of negotiations began at Barbados on February 24—even though as a gesture of goodwill the British allowed PanAm to resume the New York - Jamaica jet service on which, by combining two routes, it jumped the gun last December. Even the limited agreement on the Caribbean area, announced when the Barbados talks were adjourned on March 17, now seems in jeopardy.

It will be recalled that, over a year ago, the UK "deeply deplored" (BOAC's words) the CAB's procedural filibustering over BOAC's inclusion of Tokyo on its San Francisco - Hong Kong route. This is old history; BOAC were grudgingly granted a right to which, by gentlemen's agreement, they had been entitled since 1957. It was actually this squabble which led to the recent attempt to settle, once and for all and on a basis of parity, the route-requirements of each country.

Britain was, it seems, prepared to give Northwest liberal rights in the bustling Crown Colony of Hong Kong, one of the Far East's richest traffic points. This was a major concession, allowing a second US carrier (the existing one being PanAm) to dilute BOAC's Far East - US business. It seemed reasonable to ask for a major reciprocal concession from the Americans. Instead, the UK asked only that the US should recognize BOAC's rights to the San Francisco - Sydney route, to give BOAC a second round-the-world service via the South Pacific.

That BOAC have these rights is in no doubt as far as the UK and Australia are concerned. Though Australia bought the UK and NZ shares in BCPA (respectively 30 and 20 per cent) in March 1954, and Qantas took over BCPA's South Pacific services, the UK has never ceded its rights—clearly written down as Route 8 in the schedule to the Bermuda Agreement—to a San Francisco - Australia service.

But the Americans, it appears, laid down conditions which, by restricting BOAC to a regional service only, would have made a South Pacific route commercially useless. The US argument appears to have been that the rights were tied to BCPA. The US were not prepared to concede rights to BOAC as well as to BCPA, even though the British were prepared to concede this principle of "double designation" in respect of the Hong Kong route.

All this came up during the second round of talks in Washington (April 28-May 19). The rebuff over the South Pacific, and particularly the commercial restrictions that the CAB tried to impose on BOAC, cannot have increased the reserves of goodwill on the British side. Nevertheless, when the Americans turned to another part of the world and raised once again the four-year-old issue of TWA's "beyond rights" through the London gateway into Europe, the UK offered them a London - Cairo route. This was rejected: the Americans wanted nothing less than unlimited TWA access to London - Rome, a concession that would seriously undermine BEA's traffic as well as Britain's close relations with the Italians.

(*Continued overleaf*)

AIR COMMERCE . . .

In all this, it is believed, the UK has Italian support. More and more is Europe forming a sort of cabotage bloc against the US. The Americans guard their domestic airlines from foreign competitors: the Europeans now seem to be guarding their "domestic" airlines from US competition. Air Union bears witness to this.

The British further offered the Americans all that Seaboard and Western and PanAm wanted in the way of scheduled cargo rights beyond London into Europe. This was accepted by the US side.

What else besides the South Pacific did the British want? The requirements do not appear to have been particularly greedy.

Eagle (Bahamas), a one-Viscount operator to Miami, wanted their US operating permit to serve Fort Lauderdale, Tampa and Palm Beach from Nassau. They are entitled to this under the Bermuda agreement. But the Americans stalled because Mackey, the US operator concerned, claims that the existing designated British carrier, Bahamas Airways, caters adequately for the traffic.

Eagle (Bermuda), with the Colony's blessing, wanted deeper penetration tourist traffic-generating routes to Atlanta in addition to its existing routes to New York and Washington. This, it seems, was refused also.

BOAC apparently asked for the right to add Winnipeg as an intermediate traffic booster on its projected London - Los Angeles transpolar route, and more access to Chicago. This was not refused by the US, but it was not agreed to.

It might be fair to guess that the UK delegation found the State Department representatives reasonable. Though the US team was actually led by a State Department man, Laurence Vass, real traffic-rights power seems to be vested in the CAB. This organization, as it is required to do, certainly protects the interests of its airlines. In doing so, and being a cumbrous bureaucracy, it tends to conform to the strict letter rather than the spirit of America's international agreements with other nations. The CAB is also a slave to economic statistics. Since international agreements are essentially matters of goodwill, their rigid interpretation in the light of statistics and the quibbles of US Federal law is likely to lose friends.

An example was the request by the UK that Eagle Airways should be granted the right to a share in the transatlantic charter business. The CAB found a rule which required Eagle to limit its annual charter mileage to 10 per cent of its scheduled mileage into the USA. Eagle of course operate only two Viscounts into US terminals from Bermuda and the Bahamas, so that Eagle's transatlantic charter business would have amounted to a very limited number of flights—notwithstanding the tremendous amount of charter business generated by US carriers in Britain.

Where do we go from here? The Ministry door, as we have said, is open; but any American team which came to London without a more flexible approach to negotiations would probably be wasting its time.

One satisfactory aspect of these unhappy events is that the UK team, which was led by Alison Munro, carried with it throughout Britain's Commonwealth air transport partners. In the re-shaping of the Caribbean pattern British policy had the full support of the West Indies Government, for whom it was acting as trustee in anticipation of Federal independence next year. And, so far as is known, there were no differences of opinion—rather the reverse—with Commonwealth airlines or governments. In this fact perhaps, and also in the possibility of closer British air transport ties with Air Union, lies hope of a more flexible American attitude in the future.

J. M. R.

THE BILL IS THROUGH

THE Civil Aviation (Licensing) Bill completed its progress through Parliament with the third reading (see page 773) on May 26. The report stage had been passed on May 24.

Lord Mills, Paymaster General, remarked during the third reading that the Divisional Court's recent decision (see *Flight* last week) on the Milbanke Tours case had "opened the door wide to uncontrolled competition with the established operators." It was not now possible, he said, that the Bill could come into effect in time to bring under control similar operations planned for the present summer season, but it was unlikely that the court decision would lead to any substantially greater number of uncontrolled flights. The arrangement for transitional licences would cover operations for next summer, when the Bill would be in force.

ROOM FOR ONE MORE?

A NEW applicant has approached the ATAC for approval to operate a scheduled cross-Channel car ferry service. Overseas Aviation (C.I.) have applied to carry vehicles and associated passengers, incidental passengers and supplementary freight on a vehicle-ferry service between Gatwick and Luxembourg with Bristol 170s. Initially, frequency would be six return flights weekly, stepping up later as demand increased. Approval has been requested for a period of seven years.

Overseas thus join Silver City and the Channel Air Bridge (Air Charter), the two established cross-Channel vehicle ferry operators, in applications to carry cars much deeper into Europe than the Channel ports. Last summer, both established cross-Channel carriers applied to operate what have become known as "deeper penetration" routes; Silver City to Cologne, Cormeilles and Auxerre, and Air Charter to Paris, Dijon, Lyons, Strasbourg, Tours, Dusseldorf and Bremen.

No decision has yet been announced by the ATAC, although it is understood that the two earlier applicants have now reached compromise decisions over most of the points that they wish to serve; it was always unlikely that approval would be given for them all. These earlier applications will presumably be settled before a decision is reached on the later application.

Overseas' application is one of a number just placed before the Council. Others include requests to serve destinations such as Malta, Porto Santo (Madeira) and Shannon. Applications in bulk have also recently been made by Dan-Air, seven for UK internal services (including Bristol - Edinburgh and Manchester - Liverpool) and eight for oversea crossings. Among the latter are requests for Bristol - Rotterdam, Bristol - Knocke and Bristol - Barcelona, and three applications for a Bristol 170 vehicle-ferry service to the Isle of Man from Liverpool, Blackpool and Valley.

THE ROLLS-ROYCE DOUGLAS

ONE thing that jumps to mind when the DC-8 is mentioned is that this aeroplane is down on its brochure performance. This is doubly unfortunate, for not only is the discrepancy relatively insignificant, but it tends to mask the fact that the -8 is a superb transport. And, as Gordon R. McGregor, president of Trans-Canada Airlines, hoped when he selected the Rolls-Royce Conway to power his Douglas DC-8s the British by-pass engine gives the aircraft greater power and economy and appears to make it significantly quieter internally.

TCA eventually ordered ten DC-8 Series 40 aircraft. The three in service have been flying Vancouver - Toronto - Montreal since April 1, and on May 28 CF-TJC, the third aircraft, crossed the Atlantic. In the process it set up an Ottawa - London point-to-point observed record of 5hr 55min (3,341 miles, 562 m.p.h., approximately 20kt tailwind) which is being submitted to the FAI. The next day *Flight* flew to Prestwick and back in the aircraft, cruising at around 550 m.p.h. at 26,000ft. Leaving Prestwick (sea level, practically no wind) at 216,500lb we reached 100kt in 16sec and broke ground at 26sec. Compared with other big jets in which we have flown the initial climb seemed steep, and general tractability excellent.

It must be admitted that, like all DC-8 operators, TCA have had to use slightly higher power settings than had been anticipated in order to achieve a given cruise performance. At present the only palliative introduced by Douglas is a series of leading-edge slats inboard of the four pylons, which are covered by a door in the upper surface whenever the flaps are fully retracted. These slats are particularly effective with higher flap angles and reduce stalling speed by 8 or 9kt. A future modification will be the extension of the leading edge from the root to just beyond the inboard engines. This "Boeing 720-type" modification should slightly reduce drag and, although TCA do not make such a claim, should further improve field performance. On June 1 the airline started Toronto - Montreal - London services using aircraft with 99 economy seats and 28 first-class. Using normal high-speed cruise at M0.825 the schedule times are 7hr 5min westbound and 6hr 5min eastbound. The 1049G schedules were 12hr 50min and 10hr 55min. Frequencies are essentially daily.

"Orders for the Dart Herald," say Handley Page at the end of the aircraft's 34,000 mile Brazilian tour, "are expected before the end of the year." Several airlines are said to be seriously interested, particularly (according to an American source) Navegaçao Aereo Brasileira—NAB. Here Handley Page director E. Manley Walker shakes hands with the pilot, Capt R. Shilton of Silver City, after the Herald landed back at Woodley on May 27

Flight deck scene during a recent BOAC 707-420 transatlantic crew-training flight, one of 12 that preceded the scheduled revenue services that began, thanks to the successful ahead-of-schedule training programme, on May 27. See note below

"Flight" photograph

AIR COMMERCE . . .

BOAC's 707s IN SERVICE

TEN days ahead of the revised schedule, BOAC's Boeing 707s started to earn money on May 27, on the London - New York route. A 707 replaced a Comet 4 roundtrip, repeating the operation on May 29 and May 31. As from last Wednesday, June 1, 707s were due to operate three services until June 8, when a daily round-trip—in addition to existing Comet services—is due to be under way.

Looking further ahead, BOAC's plans call for operation of the daily Monarch service (at present Comet 4) from June 15. In addition to London - New York there will, between June 1 and June 15, be a total of five services on the London - Prestwick - Montreal - Toronto route. From June 15 there will be two services per week on this route, one to Toronto via Montreal and the other to Toronto via Prestwick.

STOPPING THE VANGUARD GAP

HOPES that BEA will be able to inaugurate Vanguard services on the London - Paris route on July 1 are now diminishing. The setback to the Rolls-Royce Tyne programme (see page 744) is such that BEA are planning on a possible three-month delay before they will be able to introduce the aircraft into service.

Fortunately for the airline, the effect is not so serious as might have been the case had the Vanguard been allocated to a larger number of routes; in fact, at the outset two aircraft only were to be deployed on the single London - Paris route. Nevertheless, BEA's forward bookings are heavy on the whole of the network, and there is no Viscount capacity to spare for redeployment to fill in the missing Vanguard capacity. The corporation is therefore seeking to charter, on a bare-hull basis, four Viscounts to resolve the situation. The crews who have been converted to the Vanguard will accordingly be reconverted to the Viscount.

As reported last week, the first Vanguard was due to be handed over to BEA by Vickers on June 15. The machine which BEA were to have in the meantime for crew-training, G-APED, was ready to be handed over last Friday. But, with the seven other Vanguards so far flown (and Canadair's CL-44s), the aircraft is suspended from flying. The most bitter pill for Vickers to have to swallow is that the ARB were expected to grant the Vanguard its Certificate of Airworthiness yesterday, June 2. But assuming that the unofficial estimate of three months is likely to prove accurate, at least the TCA Vanguard programme—which calls for delivery in August—should not be unduly affected.

MOSCOW - NEW YORK SERVICE?

POST-SUMMIT diplomatic coolness between the USA and the USSR does not seem to have diminished hopes for a regular Moscow - New York air service. In Moscow on May 27 General Loginov, head of Aeroflot, expressed the hope that agreement would soon be reached with Pan American. Replying to questions at a press conference, he said discussions had "dragged on for a long time, mainly over technical problems." The matter had now reached Government level, and he hoped conferences in Moscow and New York would result in agreement.

Giving official traffic figures for the first time, Gen Loginov said that Aeroflot flew more than 20m passengers last year, and expected to fly more than 50 million by 1965. He claimed that by the end of 1965 Russia would have considerably surpassed the total volume of carriage of the 50 American airlines.

The general added that Russia had begun thinking about supersonic airliners. "Probably in several years from now you will see them on our lines. As to the first country to have them, this is a $60,000 question, but I think we will not be the last."

WHERE ARE THE BLACKBUSHE TENANTS NOW?

FLYING ceased at Blackbushe last Tuesday. As an airport, Blackbushe is now dead; it joins the list of 16* other civil airports that have been closed down since 1939. For a while last August it seemed that some united effort was to be made to save the airport for commercial operations; an Airport Tenants' Association was formed, meetings were held and notepaper was printed, and it was agreed that every Ministry argument for wanting to close the airport could be refuted. Chief among these was the official view expressed in August that:—

"The air traffic control plan for the London area requires a limit on the number of movements at Blackbushe, and it is therefore not suited in the long term to take the eventual overflow of traffic from London's two main airports, London Airport and Gatwick. The Minister has thus been forced to the conclusion that it would be wrong to acquire the land." Apart from this, Blackbushe was operating at a loss of £200,000 per year.

But as autumn deepened into winter, the early impetus of the Tenants' Association lost momentum. As at Croydon, dissentient voices were raised at the very moment that a united front was needed. Individuals continued their efforts to keep the airport open, if not as a Ministry airfield then as a private concern; and notwithstanding earlier remarks about air traffic congestion and the spread westwards of the London Terminal Area the MoA were said to be "quite co-operative." If negotiations with private landlords had proved successful they might—it was hinted—have offered assistance with traffic control facilities. But they themselves would no longer continue at Blackbushe after May 31, 1960. With the ending of defence regulations in December 1960, all but 10 per cent of the land (which the Ministry had bought) would be handed back to those from whom it had been requisitioned and by then every building must be dismantled or "flat on the ground." To buy the land by compulsion and to extinguish the common rights over it would take special Parliamentary procedure and a very long time.

Negotiations for private ownership continued throughout the early part of this year. A local parish referendum decided in favour of continuing with the airport but the planning authority was against it. By March, when there was to have been a planning appeal, purchase and rental negotiations were still a long way from complete and a decision was required at once about taking over the Ministry's buildings. The situation was hazardous; insufficient had been decided to make continuation certain and the idea of private purchase was withdrawn before fingers were burnt. And that, for the record, was the end of Blackbushe Airport.

What has happened to the Blackbushe operators? Not all have moved to Gatwick, which in any case has no immediate hangar accommodation to offer. And because of the expense and uncertainty of building new hangars, many will continue to do their maintenance elsewhere. There is also dissatisfaction among other tenants and prospective tenants that taking a 50-year Ministry site lease for hangar space at Gatwick brings no guarantee that the airport will remain open even for five years. This might be a profitable field of investigation for the new Controller of Ground Services, Air Vice Marshal Sir Laurence Sinclair.

Of individual organizations, Airwork Services have moved their development, design and maintenance organization to Hurn, where they have both offices and a hangar, and Morton Engineering—another organization within the British United Airlines Group—have moved permanently to Gatwick. They are to occupy an extension to the existing BUA hangar.

Another engineering concern, Staravia, are now at Redfields Works, Church Cookham, Hants, and at the ROAC Map Stores, King's Ride, Ascot. But for another 12-18 months some of their business will remain at Blackbushe, on the part of the airfield that

* *Croydon, Brooklands, Broxbourne, Bekesbourne, Abridge, Fairlop, Gravesend, Warlingham, Romford, Horton Kirby, Heathrow, Hanworth, Penhurst, Heston, Wilmington, and Hendon.*

was purchased by the Ministry of Aviation for approach-equipment overhaul.

Of the air transport operators, Eagle have moved both their maintenance and operations base to London Airport as befits the long-haul nature of their operations. Dan-Air were to start operations from Gatwick on Wednesday, after establishing an office there over the weekend, but will continue to use their Lasham organization for maintenance and their Bristol office is of course unaffected by the move. Falcon are also now operating from Gatwick, but for maintenance fly to Hurn; they reckon it is cheaper to position from the South Coast than to erect a new hangar at Gatwick.

Two other new Gatwick operators are Pegasus and Orion. The latter are to operate there for this season only (maintenance will be undertaken at London Airport or Hurn) and in September they are to move to their new home at Coventry, where construction of the runway will be complete in mid-August.

Pegasus Airlines now also have offices at Gatwick, where they have transferred their operations during the past few days. Like Orion, last week they were still undecided about maintenance; the work is contracted out and details were still under negotiation.

New telephone numbers for ex-Blackbushe operators are: Airwork Services, Christchurch 2732; Morton Engineering, Livingstone 8855; Eagle, Skyport 3611; Falcon, Northbourne 671; Pegasus, Orion and Dan-Air, Livingstone 8811. Orion's extensions are 6418-20.

AER LINGUS AND BEA

A REPORT in these columns recently stated that BEA's £95,200 shareholding in Aer Lingus is to be bought by the Irish Government. Aer Lingus were quick to point out that this is not in fact the case, and there are no plans for such a transaction to take place. Neither, they further state, is there any provision in the 1959-60 budgets of the Irish Government for any such commitment.

It seems that *Flight* was misled by an item in the Irish Budget providing for repayment of an earlier transaction between BEA and Aer Lingus which is due by March 1961. But this has nothing to do with the existing BEA shareholding in Aer Lingus.

BOAC POOL REVELATION

SUCH is the secrecy that surrounds the pool agreements made by BOAC and BEA with foreign operators, and recently with UK independents, that even the smallest crumb of information is hungrily seized by information-starved observers of the scene. But the remarkable piece of news given by Lord Casey, the first Australian life peer, during the third reading of the Civil Aviation (Licensing) Bill in the Lords on May 26 was much more than a crumb. Lord Casey was, incidentally, making his maiden speech.

What Lord Casey said was that a section of the BOAC/Air-India/Qantas tripartite pool agreement "contains a stipulation by Air-India and by Qantas to the effect that they will regard the agreement between them as valid only so long as BOAC remains the only United Kingdom airline authorized by the United Kingdom Government to operate in or out of the United Kingdom by the main routes covered by the agreement."

BOAC have, it seems, done a deal with the Australians and Indians which excludes the British independents from operating scheduled services over a major part of the world air transport map.

It is little wonder that the corporations' pool agreements are closely guarded secrets if this is the kind of arrangement that is made, completely without public accountability, with the airlines of other countries. What other restrictive practices are written in to the 20-odd other secret pool agreements that BOAC and BEA have with foreign and Commonwealth airlines?

The new Air Transport Licensing Board has in fact been presented with a *fait accompli* in the matter of pooling agreements, the practitioners of which cartels are protected under Section 2(2)(e) of the new Act. [Under US law, an American operator who entered into a pool agreement would quickly find himself in court.] But even if the board has the power to call for details of pool agreements—a power which it may have under the Act (see *Flight*, May 13, page 662, col 2)—it will be unable to license any operator but BOAC for scheduled services on the eastern routes. Qantas and Air-India will not permit it.

TO SORT OUT THE CARIBBEAN

THE prospect of independence for the West Indies Federation next year has led to the appointment of a commission of inquiry on the future of air transport in the territories concerned. The commission has been appointed by the Federal Government, but it is understood that the Colonial Office is contributing to the cost.

In the chair will be Sir Frederick Tymms, a former UK representative on the ICAO Council. Members of the commission will be: Dr Keith Bradfield, assistant director-general of civil aviation, Australia; Stephen Wheatcroft, economic adviser to BEA; C. S. Sundaram, an aviation economist with ICAO in Montreal; AVM C. McC. Vincent, chairman, Trinidad and Tobago Air Transport Licensing Authority; and Abe Issa, chairman of the Jamaica Tourist Board.

The commission's terms of reference are extremely comprehensive:—

"To examine and make recommendations on the whole question of civil aviation in the West Indies, British Guiana, and British Honduras and, having regard *inter alia* to the experience of British West Indian Airways and to its financial structure, to advise upon the regulation, organization and other conditions which will best achieve the development of air services for the area and which will ensure that:—

(i) all territories of the Federation are linked by efficient, adequate and regular air services, both regionally and extra-regionally;
(ii) these services are, as far as possible, self-supporting;
(iii) there is, if possible, a steady and progressive lowering of fares so as to encourage the people of the region to become really air-minded.

"To include in their consideration and, where appropriate, to advise on the following particular points:—

(i) the review of the route network into and out of the Caribbean;
(ii) the scope of the economic operation by a West Indian airline of extra-regional services, including services to North, Central and South America and Canada, having regard to the traffic rights position under bilateral arrangements;
(iii) airline competition and pooling arrangements to safeguard local national interests;
(iv) the scope for coach services and other economy-class services into and through the federation to popularize air travel, and the scope for air freight services;
(v) the fare-structure for intra-Caribbean services;
(vi) in the context of Federation, the administrative arrangements for the regulation of civil aviation in the area;
(vii) the financial implications involved in government support for, or participation in, a national air carrier."

THE AMAZING CURTISS-WRIGHT

ON the drawing board at Curtiss-Wright is a 400 m.p.h., six-seater VTOL project. Scale models which are under construction have four propeller power eggs which rotate through 90° for VTOL and transitional flight and are supported on narrow-chord pairs of wings. The Curtiss-Wright design uses Wankle rotating-combustion engines (which are being developed by the firm under licence) and a new type of lifting propeller devised and being developed by the US concern. Three glass fibre and steel blades are used and full scale examples of these are already on flight test. Curtiss-Wright claim for their aircraft project that the majority of lift is obtained through the propellers, and that transition from vertical and horizontal flight or to hover can thus be easily completed at any time. With power off the aircraft is designed to land conventionally with the windmilling propellers providing lift. It will have a range of 900 miles, will be equipped with cabin pressurization for cruise at up to 16,000ft and will have "landing radar"—yet another new (but unspecified) device being developed by Curtiss-Wright.

Another division of Curtiss-Wright, that at Utica, which was responsible for the Air-Car ground cushion vehicle, is "currently

From New York International comes this shot, from 100ft up, of Eastern Air Lines' newly completed terminal. On all the airline's DC-8s is the hoarding "Fly Eastern Golden Falcon Jet"

AIR COMMERCE . . .

discussing with potential customers a new vehicle, the Curtiss-Wright Air-Boat, designed to carry up to 14,000lb of cargo or passengers over land, water and surfaces incapable of supporting a wheeled vehicle." According to the 1959 annual report, just published, a 4ft model of this craft is undergoing tow-basin tests under various wave conditions to determine its practicability.

ANSETT ORDER SUPER BROUSSARDS

A DEFINITE order for six Super Broussards has been announced by R. G. Ansett, who expects them to be operating in Australia and New Guinea within the next two years. They will replace some DC-3s on Australian bush services and will introduce pressurized travel on non-Government internal services in New Guinea. Mr Ansett, who made this statement in Port Moresby, does however expect approval for Ansett-ANA to operate internal services in New Guinea. Such development has not been allowed for in the Government's reorganization of New Guinea air services. At present his only hope of entering the field of internal operation there is by taking over Mandated Airlines—and their price is understood to be £500,000.

Mr Ansett's statement was followed up the next day by another from the Minister for Civil Aviation (Senator Paltridge), reminding him that he had no rights to operate in New Guinea at all. The Government has only given approval for Ansett-ANA to operate *to* Port Moresby.

BEA's THIRD COMET ORDER

TWO more Comet 4Bs have, subject to Treasury approval, been ordered by BEA, together with an option on one. This is the second BEA repeat order; after the partnership agreement with Olympic Airways was announced last year, BEA added one more to their original order for six. Aircraft against the latest repeat order are due for delivery before March 1961; their value would be of the order of £2.5 million including spares.

The original concept of the Comet 4B as a stopgap jet for BEA has changed considerably: with its pool partner Olympic Airways—an operational integration which involves the pooling of equipment as well as of revenues—it is to be a major jet operator traversing Europe's richest traffic routes with 13 Comet 4Bs, including Olympic's four.

The Comet 4 order-book now accounts for 50 aircraft, as follows: BOAC, 19 Comet 4s (delivery complete); Aerolineas Argentinas, six Comet 4s (five delivered); EAAC, two Comet 4s (deliveries this month and next); BEA, nine Comet 4Bs (six delivered); Olympic, four Comet 4Bs (two delivered); Mexicana, three Comet 4Cs (two delivered, but not yet in operation, owing to pilot strike); Misrair, three Comet 4Cs (delivery begins this month); MEA, four Comet 4Cs (delivery from December 15).

AEROLINEAS AND THE UNION

INFORMED opinion in South America that Aerolineas Argentinas may become the sixth partner in the union of South America airlines—Lineas Aereas Latinoamericanas—is significant because of possible repercussions on Comet sales in that continent. The ALA Five have already expressed interest in the Comet, and the reasons might not be unconnected with the desire of Aerolineas to be included in the consortium.

If Comets were bought they would be used for regional and international services, leaving member-airlines to attend to their own cabotage routes. Whether Aerolineas' Comets would be integrated into the ALA fleet is not yet known, but it seems unlikely that services to New York (now in competition with Panagra, PanAm and Braniff 707s and DC-8s) or to Europe could possibly be depleted.

In the context of ALA, while Aerolineas are "in," LAN-Chile (otherwise the largest partner) is now reported to be "out," at least on the basis of a working partnership. Chile is reluctant to contribute to the expense of purchasing new aircraft at a time when the country is involved in a great national disaster, but they might contribute on a shareholder basis to ensure reciprocity of traffic rights with other ALA countries.

One of the purposes of the Latin-American Union—if a secondary one—is undoubtedly to wield a stick in international aviation, particularly in respect of Freedom rights in and out of South America. The purpose of the project has been officially described as "defence of our mutual interests" and the implication seems clear. Besides, faced with faster aircraft, the Comet will be used to sell *frequency*, and should ALA become reality there is likely to be much haggling over services to Europe and the US.

So far, Brazil has kept out or been kept out of ALA, but they are far stronger aeronautically than Argentina, with whom they are not on very good terms. Should Brazil decide to go into ALA, the consequences for European and North American carriers could be tough indeed.

WHAT NAME FOR THE D.H.121?

A PRIZE of £100 is being offered by BEA to a member of the staffs of the corporation or the three Airco companies (de Havilland, Hunting and Fairey) coining the "most suitable and appropriate" name for the D.H.121. Lord Douglas, BEA's chairman, suggests that by this means the corporation may find a name "which will make BEA's new aeroplane as synonymous with the jet era as the Viscount has become among turboprops."

The chairman also announced that BEA's traffic in April was 30 per cent greater than it was last year. Although this was largely the result of Easter falling in April, instead of March, a wider measure of BEA's increasing business is given by Lord Douglas's forecasts that in the six best months of 1960—from April to September—2½ million passengers may be carried. This is more than the total for the year in 1956-57.

BREVITIES

It has been announced by Aviation Traders (Engineering) Ltd that Ansett-ANA have under consideration the purchase of conversion kits for the ATL-98. The quantity is not specified.

From an American source comes a report that KLM is shopping for a jet fleet, and there is inevitable speculation that, in the light of KLM's recent equipment rationalization talks with the SAS/Swissair consortium, the choice may be the Convair 600.

Price now reportedly being quoted by Boeing for the 727 short-haul jet project is $3.8 million (£1.36 million). Delivery date still stands as mid-1964. Gross weight, previously reported as 128,000lb (*Flight*, April 29, page 611) is now reported as 128,000-136,000lb.

It is reported in *The Times* that wreckage has been found near Overo Volcano (15,633ft) which might be that of the BSAA Tudor *Stardust* which disappeared in mysterious circumstances on September 9, 1947, on a flight from Mendoza for Santiago.

AVM Sir Laurence Sinclair, GC, KCB, CBE, DSO, has been appointed Controller of Ground Services in the Ministry of Aviation and takes up his new appointment on July 1. He succeeds E. A. Armstrong, CB, CBE, who is retiring. Sir Laurence Sinclair is at present Commandant of the Joint Services Staff College but is retiring from the RAF.

The American CAB's Bureau of Air Operations recommends that Pan American, hitherto denied US domestic rights, be granted an extension of its Pacific route between Hong Kong and San Francisco via Tokyo with New York. The Bureau says that Pan American should be "equalized" with the rights that foreign carriers [including BOAC] enjoy between the Far East and the US eastern seaboard.

The US Civil Aeronautics Board has given Eagle Airways (Bermuda) and Eagle Airways (Bahamas) permission to trade, as formally requested in March, under the name British Eagle International Airways. It seems that the Eagle services between London and Bermuda/Nassau, due to begin on October 1, will be operated under this name. An application by Eagle to operate a service between Bermuda and Trinidad has, it is reported, been refused by the Trinidad authorities.

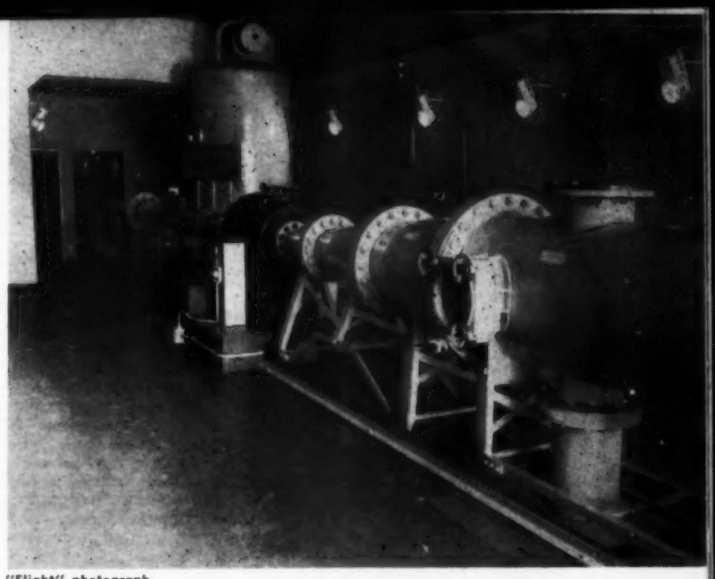
The extension of London Airport's runway No 5 will be from 9,600ft to 11,000ft as a first stage; eventually the Ministry of Aviation proposes an extension to 12,000ft. Being considered is the diversion under the runway of the Duke of Northumberland and Longford rivers.

As expected when British United Airways was formed in March, Fisons have relinquished their financial interest in the Fison-Airwork helicopter group. Operations will now be integrated with those of Airwork's other helicopter subsidiary, Bristow, to form the helicopter division of British United Airways—which will be, say BUA, "the chief helicopter operator in the country."

Package purchase by Maitland Drewery of five Viscounts from Air France, at a price which has not been disclosed, is at a late stage of negotiation. The aircraft are at up-to-date modification standard and were to have been delivered to Marshalls of Cambridge this week. Operating from Gatwick after ARB re-validation they will be used this year for closed-group charters and next year for ITs. Some may also be chartered out on a bare-hull basis.

A total of 300hr will be flown by Argosy G-APRN (the fourth aircraft) in the course of the route-proving programme now under way. This is the final phase of the ARB certification programme. The route trials, which began on May 11, are in four stages: 50hr (complete), 75hr (complete), 75hr and 100hr. The countries which the Birmingham-based G-APRN is visiting are: Switzerland, Spain, Denmark, Sweden, Germany, Eire, Italy. The route-proving programme is due to be completed early next month.

The possibility that Riddle will, after all, order the Argosy arises from the pending decision by the USAF on the award of a military contract ("Logair") to this all-freight operator. Riddle are reported to have intimated to Hawker Siddeley their intention, given the "Logair" contract, to order five Argosies for delivery before March 1961, and that a deposit was paid in March. An AWA spokesman said last week: "Riddle placed an order with us last year for three Argosies with an option on two, and this contract has never been cancelled."



The 30in reflected-shock tunnel at Teddington. In the foreground is the high Mach number working-section, to the left of which are the expansion nozzle, low Mach number working-section and main channel

"Flight" photograph

Aerophysics at NPL

FOR those who sample the superb Open-Day menu of scientific goodies offered annually by the National Physical Laboratory at Teddington, mental indigestion is a familiar hazard. But such is the variety of choice that only rarely does one particular aspect predominate. This year was a notable exception for the Aerodynamics Division, whose literal shock-treatment for visitors last week lay in uncovering an impressive selection of hypersonic facilities.

Using conventional wind tunnels to provide speeds greater than approximately M4, it becomes necessary to heat the air supply so that the air does not liquefy when it is cooled on acceleration in the tunnel nozzle. Two tunnels now being completed at NPL will accordingly be equipped with heaters, and are expected to reach M7. A third tunnel under construction employs an alternative approach, using unheated helium (which liquefies at a very low temperature) instead of heated air. This helium tunnel is expected to achieve over M20, with the further advantages of relatively high Reynolds numbers and relatively low driving pressure ratios.

Problems arising from changes in the physical properties of air near a body in hypersonic flight, however, cannot be studied in this way. These changes may be caused by dissociation of the molecules of the air into atoms, or by ionization effects, and for laboratory tests to be valid air must be used as the test gas and the temperatures of fullscale flight must be reproduced. In conventional wind tunnels this is not possible, and so shock tubes and shock tunnels are used in which the operating time is so short (of the order of 1 millisec) that the temperature of the apparatus does not rise excessively.

NPL SHOCK TUBES AND SHOCK TUNNELS

Channel diam (in)	Channel length (ft)	Max driving pressure (atm)	Working section diam (in)	Completion date
3	34	300	8 or 16	1956
2	14	130	—	1958
2	20	130	—	1958
6×3½	15	500	—	1959
2	10	500	—	1959
2	20	1,000	8	1960
6	54	1,000	16 or 30	1960

NPL HYPERSONIC TUNNELS

Working section (in)	Mach no range	Stagnation pressure range (atm)	Completion date	Remarks
5 dia	3–20	30–150	1960	Intermittent helium tunnel
5×6	1.5–5.5	0.2–25	1961	Continuous from 4,750 h.p. compressor; heating to 750°K
15×10	0–7	0.3–15	1961	Intermittent; storage heater to 650°K
4-7 dia	0–10	0.0001–5	1960	Continuous low-density tunnel with plasma-jet heater
8 dia	5–15	4,000	1960	Hotshot tunnel with 5×10^4 Joules electrical storage

In a simple shock-tube two sections of a straight duct are separated by a diaphragm (normally aluminium or Mylar plastic), with driving gas at high pressure on one side, and the test gas at low pressure on the other. When the diaphragm bursts, a shockwave travels along the tube, compressing, heating and setting in motion the test gas, and is followed by a volume of the test gas at uniformly high pressure and temperature. To produce strong shocks and hence high temperatures a driving gas of high sonic speed is used: in many of the NPL facilities this gas is hydrogen, and in one the speed of sound is further increased by heating the hydrogen electrically.

In constant-section shock tubes using air as the test gas, the Mach number of the flow behind the shock is limited to about 3. Higher Mach numbers can be achieved by using a shock tunnel, which can be regarded as a two-stage shock tube having a second diaphragm beyond which is an expansion nozzle leading to a larger-diameter working section. Here the "first-stage" shock tube acts in effect as the compressor and heater of a wind tunnel. To achieve realistic densities and Reynolds numbers in the expanded working section, very high driving gas pressures—up to 1,000 atmospheres at Teddington—are required because of the pressure drop in the expansion nozzle.

Two types of shock tunnel are operated at the National Physical Laboratory. Perhaps the most familiar type is the reflected-shock tunnel, in which the primary shockwave is reflected from the initially closed end of the tube, passing through the contact surface between the driving and test gases without further reflection (this particular case is known as the "tailored condition"). The second (nozzle) diaphragm then bursts and the hot gas expands into the working section.

The second type is the free-piston gun tunnel, in which a light free piston is located against the downstream side of the first diaphragm. When the diaphragm bursts the piston is accelerated and a shockwave forms ahead of it (which in fact travels faster than the piston itself). This primary shock reflects from the second diaphragm, and the reflection process is repeated between the piston and the diaphragm until the pressures on each side of the piston are equal; the diaphragm bursts, and the volume of gas ahead of the piston expands into the working section. In theory the test run ends when all the hot gas has passed into the nozzle and the piston has blocked off the nozzle entry.

Comparing the performance of these two types of tunnel assuming the same driving conditions, the free piston gives a longer running time without the restriction of "tailoring." The strength of the barrel and nozzle, however, must cater for transient gas pressures up to 20 times the chamber driving pressure.

The various hypersonic facilities in operation and prospect at Teddington are listed in the two tables. The largest is the 30in reflected-shock tunnel shown in the heading photograph, the constituent sections of which, from driving end to vacuum-plant connections (i.e., left to right) are: hydraulic ram to retract chambers and channel for insertion of diaphragm; first high-pressure chamber (6ft×6in bore, 1,000 atmospheres); first diaphragm; second high-pressure chamber (12ft 6in×6in bore, 1,000 atmospheres); second diaphragm; main channel (38ft 9in×5.5in bore, 1,000 atmospheres), with shock detector stations and low Mach-number working section; expansion nozzle (11° 26′ total angle); high Mach-number working section; and connections to vacuum plant.

The Aerodynamics Division's unique circular building, which in the old days housed the whirling-arm used for low-speed work, now sports the title AEROPHYSICS LABORATORY over the door. Inside, the equipment includes an 8in (working section) shock tunnel which can use either the reflected-shock or the free-piston technique; and a 6in×3.5in shock tube used for studying the interactions of the reflected shock with the boundary layer on the tube wall, and with the contact surface.

Under construction in the building were a low-density tunnel incorporating five four-stage booster diffusion pumps, and which may use an arc-heated plasma jet to supply a high-temperature airstream; and an 8in diameter hotshot tunnel. In this a pulsed electrical discharge is used to heat and raise the pressure of the air, which then expands through a nozzle into the test section.

Also exhibited was a delay-line shock generator, to be used with a forthcoming electrically operated shock tube designed to give a constant-velocity shock (up to M30) in argon. The tube will be enclosed by a delay line consisting of capacitors tapped on to a coil: this is charged to a high voltage and short-circuited at one end, whereupon a current wave travels down the line, together with a magnetic field, which acts as a solid piston on the ionized gas ahead of it.

Many other aspects of the work of the Aerodynamics Division were on show, including studies into sweptback and delta wings in steady flow: unsteady flow problems in aircraft and missiles; and boundary-layer development. A wide range of non-aeronautical work is also carried out, including investigations into wind effects on structures such as bridges and chimney stacks.

THE INDUSTRY

Silencing at Prestwick

A NEW ground-running silencer for Canadian CF-100s, designed by Industrial Acoustics Co Ltd and called the Durastack, has been fabricated by Burnley Aircraft Products Ltd and installed at Scottish Aviation's factory at Prestwick, where Canadian aircraft are overhauled.

The silencer, illustrated here, has two direct couplings and augmenter ducts leading to a single welded-steel working chamber. Soft asbestos-covered adapter nozzles fit right over the engine tail-pipes so that no noise escapes at this point. Immediately aft of the couplings are specially shaped intakes through which cooling air is drawn into the main hot gas-flow, reducing efflux temperature from 1,200°F to about 600°F. The main chamber contains an arrangement of baffles which are fabricated of heavy-duty steel plate to permit higher working temperatures and more effective silencing. The exhaust is vented vertically upwards through a rectangular duct whose height can be increased, if required, to lead gases farther away from an installation or to provide still further silencing. An adapter has also been provided to allow Canadair Sabres to use the Durastack.

The silencer was made under the patents of the parent American company, Industrial Acoustics Co Inc, who have supplied many silencers in the US and Canada. The English company has already received orders from Norway and elsewhere and has also produced a very successful portable silencer for the Scimitar (*Flight*, April 15). During preliminary tests made at Prestwick the Durastack effected a noise reduction of over 25db and normal conversation was possible in the zone of greatest noise within 300ft of a CF-100 running at full power. The installation illustrated is stated to cost about £11,000.

Chloride's New Laboratories

THE new central research and development laboratories of the Chloride Group at Clifton, Swinton, Manchester, were officially opened on May 20 by A. W. Browne, chairman of the Chloride Electrical Storage Co Ltd. The two principal buildings of the facility, which has a total floor area of over 41,500 sq ft, house chemical, electro-chemical and metallurgical laboratories and workshops, and a library and conference room. The staff of 180 includes 40 qualified specialists.

Among work already in progress is the development of batteries for guided-missile applications and for powering meteorological-balloon recording and transmitting equipment; research is also being done on water-activated batteries for air/sea rescue equipment and comparable applications.

"Flight" photograph

This view of the Durastack ground-running silencer shows the couplings for the tailpipes of a CF-100. A photograph of the installation with an aircraft coupled to it appeared on page 707 of last week's issue

Low-temperature Versatility

USE of sub-zero-temperature equipment for various test, conditioning and assembly processes is the subject of technical notes by Farnell Instruments Ltd, of Light Industrial Estate, York Road, Wetherby, Yorks. The examples given include equipment for missile-component and control-system work. Standard environmental chambers with mechanical refrigeration systems are available with pull-down to approximately −250°F. When lower temperatures are required use can be made of liquid nitrogen, helium or hydrogen as refrigerants. Products can be subjected to near absolute zero (−459.6°F) conditions in baths of these cryogenic materials within a cryostat or similar apparatus.

Dehydration by means of refrigerator equipment is also a widely-used process. One well-known instrument company manufacturing gyros containing hydrogen and helium employs chilling equipment in which these gases are chilled to approximately −135°F before they are pumped into the gyro. There are also many instances in the working of metallic raw materials where low temperatures can profitably be employed, and examples given by Farnell Instruments include the use of refrigeration to delay the natural age-hardening of certain aluminium alloys; stress relief in light alloy castings; and stabilization of steel.

An increasingly widely-used assembly process involves expansion fitting—the reverse of the familiar process of shrink-fitting, to which it is claimed to be superior principally by reason of the fact that the chilled parts are not metallurgically changed or otherwise damaged, that presses are not required for assembly, and that cold parts are more easily handled than hot ones.

Farnell Instruments Ltd are the sole United Kingdom agents of Cincinatti Sub-Zero Products of Ohio, USA.

IN BRIEF

Samuel Fox & Co Ltd, a subsidiary of United Steel Companies Ltd, are to spend over £4½m on a development scheme to expand ingot steel production from 400,000 to 500,000 tons per annum.

The College of Aeronautics has ordered a Pegusus digital computer from Ferranti Ltd. Delivery is scheduled for next month, and the equipment will be used to teach students the fundamentals of programming and computer techniques, study of which is already included in the curriculum.

Appointed to the board of Flight Refuelling Ltd is their commercial manager, Wg Cdr Hugh C. Johnson. Throughout his career with the company, which he joined 26 years ago, he has held a senior executive position; and during the Berlin Airlift, in which Flight Refuelling played an important part, he was responsible for organizing the company's effort both in this country and in Germany

A large Series 80,000 in-line digital display unit, approximately four times the size of the standard Series 600 unit, has been marketed by Counting Instruments Ltd, 5 Elstree Way, Boreham Wood, Herts. This new unit can display a character 3¾in high by 2in wide, compared with the 1in × ¾in size of the standard type; and its applications include process projection and supervisory control panels, display boards, equipment tests and types of instruments calling for fast and easy reading.

Ether Langham Thompson Ltd have formed a new subsidiary, Ether Langham Thompson (Italiana), with offices and factory at Bisleri 19, Milan. It is to manufacture and market products of the ELT subsidiary companies, Ether Ltd, J. Langham Thompson Ltd, Electro Methods Ltd, Datum Metal Products Ltd and Automation Systems & Controls Ltd. In addition, agency agreements have been completed between the Italian company and a number of other companies in the field of instrumentation. The chairman of the new Italian company will be J. Langham Thompson.

Charles Irving, Dowty public relations adviser, has now been appointed head of public relations to the group.

G. W. Thompson has been appointed exhibition manager to the Firth Cleveland group of companies.

BTR Industries Ltd announce the appointment of F. S. Lloyd as purchasing officer for the BTR group. He was formerly with, in succession, Mullard, Marconi Instruments and Crompton Parkinson.

Standard Telephones & Cables Ltd have equipped a mobile exhibition unit carrying a range of typical components manufactured for the telecommunications and electronics industries. The intention is that the unit shall visit designers and engineers at their own works.

Three further Heenan Multiform automatic strip forming machines are to be brought into operation at the Treforest (Glam) works of Simmonds Aerocessories Ltd to meet the increasing demand for the company's Spire Speed Nuts.

P. Blandford informs us that he recently relinquished his post as general service manager at Vickers-Armstrongs (Aircraft) Ltd at Weybridge, after some 14 years with the company, and has taken an appointment with Ferodo Ltd, the makers of friction materials, at Chapel-en-le-Frith, Derbyshire.

From Flexible Veneers Ltd of Cobbs Court Buildings, Carter Lane, London EC4, come details of Agastrip flexible veneer strip (paper-backed) and Agatape flexible veneer tape (self-adhesive). Of actual wood, these materials are used for the edging of chipboard, plywood, etc, to give a neat finish.

Cellon Ltd "announce with regret" the decision of W. F. Wilson to retire from their board upon acceptance of an appointment as consultant to the group. During his 35 years with the company, they add, he has made many friends on both the consumer and production sides of the finishing industry.

Sciaky Electric Welding Machines Ltd, in association with Pye Industries Ltd, have announced the formation of an Australian company called Sciaky Australia (Pty) Ltd, to manufacture, install and service resistance welding equipment for the Australasian continent. A new factory under construction at Fairfield, NSW, for the new company is already going into production.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Airline Captains' Pay

I AM grateful to Mr Beven [Correspondence, May 20] for drawing attention to the anomalous position which exists in connection with airline captains' pay. This is one which the Association has been attempting to correct for many years. It was thought that Section 15 of the Civil Aviation Act was designed to ensure that independent operators observed the same terms and conditions of employment as the corporations for persons engaged in comparable work; but, so far, in successive visits to arbitration the principle of pilots flying the same aircraft receiving the same pay has not been accepted except in respect of two isolated cases brought to the attention of the Industrial Court under very special circumstances which do not obtain in the mass of services operated by the independent operators. The situation to which your correspondent draws attention has been one which the Association has condemned over a long period of time.

Incidentally, the result of the latest application to the Industrial Court was not a rejection of the Association's claim for salary increases. The Court referred back that claim, in respect of quantum to the two parties (the Association and the independent operators), for further examination, whilst laying down that the structure which permits the anomalous situation to exist should remain in being.

Harlington, Middx D. FOLLOWS,
General Secretary, British Air Line Pilots Association

Cranwell's Earliest Days

THE article "Cranwell's Earliest Days" [February 5] was read by the undersigned with great interest, as I served at this unit from the late summer of 1917 to February 1918. I was, however, disappointed with the lack of information covering the First World War role and activities of Cranwell, which at that time was one of the most important training establishments of the RNAS.

It is true that many hundreds of pilots were trained at Cranwell prior to 1920 including the late King George VI, who, as Prince Albert, Duke of York, was stationed there 1917-18. No doubt there are many hundreds of ex-RNAS personnel who will recollect that smooth and flawless aerobatic performance by Flt Cdr Hinchcliffe in his black-strutted B.E.2C.

Mr Corlett's article states that the training of boy mechanics started in February 1920, whereas active training of boys in wireless telegraphy was in operation, to my personal knowledge, in the early part of 1917, if not before. The school buildings were located down past the MT garages and behind the officers' quarters on the Cranwell village road, past the site of the railway spur line station. Here instruction was given in the morse code, the theory of wireless telegraphy, the servicing of receivers and transmitters, semaphore and morse flag signalling, flashing, the international and naval code flags and operating procedures.

Cranwell at that time was commanded by Rear Admiral John Luce, who previously commanded HMS *Glasgow* at the Battle of Coronel in the early days of the war. The commander was Cdr Talbot, and Flt Cdr Lidderdale was the first lieutenant or "No 1." The CO of the wireless school was Lt Cdr J. C. Collinson, with WO Hartley as the chief instructor.

The boys attending the school were mostly recruited at Wormwood Scrubs Naval Air Station in the West End of London, and at the time of entry were between the ages of 17 and 17½ years, in order that by the time they were 18 years old, they would be fully trained aerial wireless operators and observers. Thus the boys were the nucleus of the first non-commissioned aircrew in the RAF when it was formed on April 1, 1918.

I should be pleased to enter into correspondence with the author of the article, on which he should be warmly congratulated.

Ottawa N. A. NUNN
(ex-RNAS, and Sqn Ldr RCAF, 1940-46)

An 1867 "Jet"

IN the February 19 issue of *Flight* I wrote about the Russian engineer, Theodor R. Geshvend, who designed and built a jet aircraft. Recently I discovered another Russian pioneer of jet flight—the Guards Artillery captain, de Telecheff, retired (1828-1895) who lived in Paris. Here he became imbued with burning enthusiasm for heavier-than-air flying, and he and the lawyer Michel Michniewicz in August 1864 designed an aeroplane carrying 120 passengers(!), their provisions and water, with a top speed of 40km/hr, for ten hours of flight. This giant aircraft was powered by an engine. This invention, entitled "Un système de navigation aérienne" was patented in the Ministry of Commerce and Travaux Publiques on October 1864. Capt de Telecheff offered this invention to the Russian War Ministry, but a commission of members of the Academy of Sciences and War Ministry inferred that the invention was a dream!

In August 1867 de Telecheff patented in Paris another invention, "Un système perfectionné de navigation aérienne"—an aeroplane (triangular, "delta" shape) powered by a jet engine, the fuel kerosine. It is a strange coincidence that this triangular aircraft is very similar to the Soviet triangular jet aeroplane built by P. O. Sukhoi.

From the records of the VII Department of the Imperial Technical Society, 1880-1890, I found that de Telecheff in 1885 submitted to the War Minister of Russia the design of an airship—a combination of an aerostat with an aeroplane, but this invention was also declined.

The patents of the inventions of de Telecheff and the model of the delta jet plane remain in the Musée Nationale d'Aéronautique at Paris. It is of interest to note that both inventions of de Telecheff were unknown in the Soviet Union, and the aviation public opinion of the USSR was very surprised when I received information and the designs of both aircraft from Paris.

Tartu, USSR E. MEOS

"Air Transport as a System"

ALTHOUGH there is much in Mr J. E. D. Williams' two articles [April 22 and 29] with which one might agree, some of his assertions will certainly cause surprise, and perhaps some amusement, to any professional specialist navigators who chance upon them.

Taking his comments on long-range navigation first, there is the rather wild statement that aircraft (over the North Atlantic) rarely know where they are and never know where they are going. An aircraft fitted with a properly operating Dectra installation does know its position within reasonable limits, and although the very experienced navigators of non-Dectra-equipped aircraft have to use methods which tell them only where they were in the recent past, the lag between the time of the fix and its appearance on the chart—one to three minutes normally—makes a DR position ascertained immediately afterwards a reasonably accurate assessment of the aircraft's position. Also, since the other reason for fixing is to obtain the immediate past wind velocity, so that in conjunction with the other information available the most probable immediate future wind can be assessed by the navigator to give him his most probable future track and ground speed (and only occasionally does this prove to be violently in error) the navigator does have a good idea as to the aircraft's future flight-path.

A great advantage of Doppler so far as the North Atlantic, North Pacific and Arctic routes are concerned is that it should show the navigator at any time he cares to glance at it, with the aid of his computer, the present wind velocity; in the past he had only his forecast and past found winds. This will enable him to assess the future likely wind with greater accuracy without the present time lag thus improving tracking and ETAs.

Long-range navigation is admittedly complicated but it is not "an unmitigated mess." It is also quite wrong to say that the navigator is subjected to "a mass of unco-ordinated . . . irrelevant information." The navigator obtains almost all his own flight navigational information and does not waste time obtaining anything irrelevant, and the information he co-ordinates himself. That is his job.

Mr Williams does not seem to be aware of current astro methods and does not appear to understand how they still retain considerable importance—even at 400-500 knots! The "extensive manual computation" occupies 4min to 5min for a three-star fix, the whole operation from picking up the *Air Almanac* to the appearance of the fix on the chart taking approximately 17min when the navigator is really experienced. With position-lines plotted between sights the time difference between the fix and its appearance on the chart is 2min, i.e., 20 n.m. at 600kt—not "100 miles back." In mid-ocean, where the angular cut of two Loran position-lines can be quite small, one N-S astro position line taken 6min before the time of the fix and run-up often improves the accuracy of the fix very considerably. If astro alone has to be used, fixes at 40min intervals are well within a good navigator's capacity. If Loran (plus Consol if available) is being used a fix every 30min is normal but this can be reduced to every 15min if high winds differing wildly from the forecast are being obtained.

A Loran position-line under average conditions takes the navigator about a minute to obtain—hardly "fairly laborious"—and whether it provides only "limited information" is arguable. Whether or not one can fix one's way across the Atlantic using Loran alone depends upon a number of factors, but it is not infrequently done. The major factors are (a) day or night (greater night range); (b) the route, the routes north of rhumb-line London - Gander and south of Cape Farewell having the best coverage; (c) ionospheric conditions; (d) the aerial system of the aircraft.

Often the arrangement of the Loran aerial appears to have been delegated by the designer to the most recently joined office boy, although, remembering the number of aircraft that have

CORRESPONDENCE . . .

gone into service with a flight-deck crew which differed from that for which they were designed, perhaps one should have some sympathy with designers when cursing them for wrongly allocated space and instrument arrangement.

Clearly, for quite a number of years on the routes under consideration the navigator will have to carry on with the present aids, plus perhaps Doppler and/or Dectra, and continuing his monitoring and co-ordinating work. The tendency for over-publicized new aids not to come up to expectations in the hurly-burly of airline service must not be forgotten. So far as a long-range fixing system is concerned, and until something new and reliable appears and can be internationally agreed upon, as an interim measure Consol stations at Cape Farewell, Keflavik, Bermuda and on the Azores would be a great help—perhaps supplemented, if and when available, by an improved Dectra system. Aid coverage on the Bermuda - London direct sector in daylight is at present very poor.

The ATC problem is (as used to be said of the poor) always with us, and few of us will quarrel with Mr Williams' strictures here. It is stated that the task of designing a new ATC system is "totally unsuited to government departments or to airlines." But who else but the servants of the governments and airlines have the technical knowledge to produce anything that is even a basis to work on? Short of a 100 per cent accurate heading reference Doppler cannot be used as a separation system because its errors are peculiar to each individual aircraft. In the case of Dectra its errors tend to apply to all aircraft to a similar degree. It can be held that the separation minima considered necessary by ATC are governed by the accuracy—or lack of it—of the navigation of the operator having the lowest navigational standards. Some of them are believed to have standards that are far too low and the view is held in some quarters that this trend is spreading.

Mr Williams lays down a far-from-clear specification for a long-range navigation system to integrate with an ATC system. Agreed the need is there, but long experience leads me to think that he is crying for the Moon!

The not-very-large international band of professional specialist navigators whose self-developed techniques have helped to make possible the safe navigation of the millions of passengers on the long oceanic and polar routes, virtually without recognition by both public and the air transport industry are not, I would imagine, unduly worried by the situation.

Edgware, Middx EDWARD PALMER

FORTHCOMING EVENTS

June 3-4. RAeC: London-Cardiff Air Races, Rhoose Airport.
June 4-12. Royal Air Force Gliding and Soaring Association: Gliding Week.
June 4-19. German Aero Club: World Gliding Championships, Butzweiler.
June 5. Champagne Aero Club: International Rally, Rheims.
June 5-6. Leinster Aero Club Rally.
June 5-6. Fréjus - St Raphael Aero Club: International Provençal Wine Rally.
June 5-6. Vichy Aero Club: International European Aviation Meeting.
June 5-6. Alsace Aero Club: European Light Aircraft Meeting, Strasbourg.
June 6. RAFA Air Display, Hucknall, Nottingham.
June 6. Women's Junior Air Corps: Flying Display, White Waltham.
June 8. Kronfeld Club: Film on Antarctica Crossing.
June 10. RAeS Rotorcraft Section: "Helicopter Vibration," by Dr J. P. Jones.
June 11. College of Aeronautics, Cranfield: Public Open Day. Also Cranfield Society a.g.m. and Dinner.
June 11-12. Chalet Aero Club: Touring Aircraft Meeting.
June 12. International Landing Contest, Brussels.
June 12. Wolverhampton Aero Club: Competitions Day.
June 12-18. International Institute of Welding: Annual Assembly in Liége.
June 17-18. Lozère Aero Club: Rally, Mende-Brenoux.
June 18-19. West Aero Club of France: 14th International Wine Rally, Angers.

AUSTRALIA'S RAIN-MAKING EXPERIMENTS

THE Australian Council for Scientific and Industrial Research has officially announced that five years of rain-making experiments from CSIRO and RAAF aircraft conducted in the Snowy Mountains area of South-East Australia have been "highly successful." The chairman, Dr F. G. White, states that Australian scientists have a "sure method" of increasing rainfall by the seeding of clouds with silver iodide from aircraft.

This is the first official notice that the Australian system is now proved. Experiments began in January 1947, when Dr E. Kraus (a Czech who flew with the RAF) and Patrick Squires (an Australian meteorologist) made the first trial flights. Using a RAAF C-47, they generated their first rain on February 5, 1947. These tests were made with dry ice dropped into the clouds, but the CSIRO soon realized this was a dead-end experiment. Silver iodide in solution was used first in 1951 and has been employed ever since.

The Radio Physics Division of CSIRO, which has been responsible for all this work, also used an Anson for some years, but late in 1957 they imported two Cessna 310 Bs.

Dr E. G. Bowen, the branch head, reports that the experiments have been successful in the Snowy Mountains area and also in the New England region of Northern New South Wales. The induced rainfall in the New England area has actually been greater than in the Snowy Mountains, but it has not yet been practical to measure the increase there. In the Snowy area, the highest region on the Australian continent, the increase has been a definite 15 per cent, according to Dr Bowen. In South Australia experiments had resulted in absolute failure, but in the Darling Downs country of Queensland some success was reported, though measurement was not possible.

The Snowy Mountains results had proved that an aircraft could be responsible for creating general rainfall over an area of 4,000 square miles under the right conditions. Rain would begin to fall within 30min of seeding. It would not stop until weather conditions altered.

The news has been regarded as providential by Australian pastoralists. If a continuous increase of 15 per cent of rainfall could be induced it could mean a profit of £3,000,000 a year. The Snowy Mountains area is already the centre of enormous hydro-electric development. The Water Research Foundation says that £3,000,000 would be secured from the greater electric power output and the increased volume of water available for irrigation.

The area is ideal for rain-making as it has the necessary weather conditions, with plenty of the right type of cumulus cloud. These conditions also exist in the Northern Territory's Far North tropical region. It is possible that there the CSIRO system could extend the monsoon season. Western Queensland and New England are two other favourable areas.

The value of these discoveries to Australia may be gauged by the fact that when a bad drought occurs it can affect 80 per cent of the entire land mass. One single drought period early this century halved the sheep population, which took 20 years to renew. The 1951 drought in Queensland alone cost that State £20,000,000 in direct stock and produce losses.

When the dry-ice experiments were successful in 1947, Australians jumped the gun with prophecies. It was then found that so much dry ice was needed for each acre of cloud that the whole thing was impracticable. The US meanwhile had tried silver-iodide solution; this is burned in a flame to form crystals so small they look like a fog. It forms an artificial freezing medium. Rain falls from clouds when they cool enough, as we all know. This is a method of inducing that cooling process.

The snag is that the method works only on high cumulus masses and these are only found in certain areas. They are unfortunately absent just where they are needed most—over the marginal desert areas, where sheep and wheat today share the thirsty country. Even a very small increase in annual rainfall in those areas, covering perhaps a million square miles of the total 3,000,000, would have the most dramatic results on output.

If CSIRO can develop rain-making to the point at which the wheat-sheep marginal areas can secure even a 10 per cent rise in annual rainfall, just another 1½-2in a year, production would be doubled. That is an economic reward which could not be paralleled by any other use of aircraft anywhere else in the world.

STANLEY BROGDEN

HUCKNALL DISPLAY

A VARIED programme has been arranged by the Eastern Area of the RAFA for their sixth annual Whit Monday air display, being held at Hucknall Aerodrome, near Nottingham, on June 6. Items range from RAF and USAF participation to solo performers, including Leon Biancotto in the Nord 3202 he is using for this year's aerobatic competitions. The RAF "stars" will be the black Hawker Hunters of No 111 Sqn and USAF representation is to include F-100D Super Sabres, F-101A Voodoo and B-66B Destroyer. The airfield is open from 11 a.m. and joy-rides will be available before and after the display, which begins at 2 p.m.

INTERAVIA'S BIG ANNUAL

NOW available is the 1960 edition of that classic work of reference, *Interavia ABC*—the five-language (English, French, German, Italian and Spanish) annual publication of AICMA, the Association Internationale des Constructeurs de Matériel Aéronautique. This world aviation directory, running to nearly 1,300 8in×11½in pages, contains over 2,000 new entries, mainly in the field of electronics, and the publishers state that the whole work represents a 60 per cent revision of the 1959 edition. It is obtainable at £4, including packing and postage, from Interavia (United Kingdom) Ltd., 149 Fleet Street, London EC4.